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Report of the Committee of the Franklin Institute of Pennsylvania for the Promotion of the Mechanic Arts, appointed to ascertain, by experiment, the Value of Water as a Moving Power.

[CONTINUED FROM THIS JOURNAL VOL. X., 2ND SERIES, P. 371.]

PART SECOND.

In continuation of their report the committee on water power proceed to give deductions from the experiments, the particulars of which have been already stated. As a convenient division of the subject the experiments will be discussed under the heads of I. OVERSHOT WHEELS; II. UNDERSHOT WHEELS; III. BREAST WHEELS, and IV. GENERAL INFERENCES pertaining to the different modes of using water. To give authority to the conclusions of the committee the examination of the experiments will be minute, but for the benefit of those who wish rather to apply the results than to scan them closely, the THIRD PART of the report will contain rules founded on the general conclusions, and applicable directly to the questions occurring in the use of water as a moving power.

I. OVERSHOT WHEELS.

1. *The ratio of effect to power.*—It is important in determining the ratio of effect to power, under different circumstances, to employ all the experiments which the tables afford; on this account, as the results for wheel No. 1, when used as an overshot, were obtained with three different forms of gate, it will be necessary to show first that these forms were of equal, or nearly equal, efficiency. This will be done in the following tables, from one to five inclusive. In these tables the velocity of the wheel will be also entered for subsequent use and comparison.

The maximum result under each head is given in tables first, second, and third, as collected from tables A, B, and C., vol. viii, pp. 85, 88, 89.

The numbers in the first column refer to those of the experiments in column 1 of the general tables. The second column contains the head above the bottom of the gate, from 2 of the general tables. The third contains the head and fall, from 13. The fourth, the width of aperture, from 5. The fifth, the velocity of the wheel, from 11. The sixth, the ratio of effect to power, from 17. The next three columns, of tables first and third, contain, severally, remarks from the detailed tables, the mean ratio deduced from the sixth column, and the mean velocity of the wheel from the fifth. The column of remarks is not needed in the second table.

TABLE FIRST.

For the comparison of gate a with gates b and c. Collected from table A. (VOL. VIII. P. 85.)

No. of Experiment.	Head above gate.	Head and fall.	Aperture.	Velocity of wheel.	Ratio of effect to power.	Remarks.	Mean velocity of wheel.	Mean ratio of effect to power.
	feet.	feet.	inches.	feet.			feet.	
5	2.75	23.00	0.50	5.28	.829			
11	"	"	1.00	5.43	.839			
14	"	"	1.25	5.58	.834		5.43	.834
18	2.25	22.50	0.75	5.21	.820			
23	"	"	1.00	6.01	.835			
31	"	"	1.25	5.50	.837	Last experiment	5.57	.831
33	1.25	21.50	0.50	4.65	.839			
37	"	"	0.75	4.77	.850			
40	"	"	1.00	5.28	.850			
45	"	"	1.25	4.83	.845	Last experiment	4.88	.846
50	0.50	20.75	1.25	4.44	.872		4.44	.872
54	0.25	20.50	0.75	3.99	.810	Water too low		
56	"	"	1.00	3.76	.828	to fill aperture	3.87	.819

TABLE SECOND.

For the comparison of gates b with gate a and c. Collected from table B. (VOL. VIII. P. 88.)

No. of experiment.	Head above gate.	Head and fall.	Aperture.	Velocity of wheel.	Ratio of effect to power.	Mean velocity of wheel.	Mean ratio of effect to power.
	feet.	feet.	inches.	feet.		feet.	
3	2.75	23.00	0.75	7.52	.838		
8	"	"	1.00	7.66	.832	7.59	.835
15	1.25	21.50	1.00	5.28	.839	5.28	.839
18	0.75	21.00	1.25	5.50	.836	5.50	.836
22	0.50	20.75	1.25	4.65	.832	4.65	.832

TABLE THIRD.

For the comparison of gate c with gates a and b. Collected from table C. (VOL. VIII. P. 89.)

No. of experiment.	Head above gate.	Head and fall.	Aperture.	Velocity of wheel.	Ratio of effect to power.	Remarks.	Mean velocity of wheel.	Mean ratio of effect to power.
	feet.	feet.	inches.	feet			feet.	
2	2.75	23.00	1.00	5.35	.814			
18	"	"	"	6.62	.809	Air vents open.	5.99	.811
5	1.25	21.50	1.25	6.20	.845			
8	"	"	1.50	6.10	.838		6.15	.842
11	0.75	21.00	1.25	4.77	.842			
13	"	"	1.50	5.07	.841		4.92	.841
16	0.50	20.75	1.50	4.60	.831	Water too low to fill buckets.	4.60	.831

The following table contains the averages drawn from the three foregoing tables. In deducing the ratios of the mean velocities of the wheel, the least velocity in the table is taken as unity; and in comparing the mean ratios of effect to power the least ratio is also assumed as unity. The results with those heads only, which occur in all the three cases, are brought into comparison.

TABLE FOURTH.

Comparison of gates a, b, and c. Collected from tables First, Second, and Third.

	Nos. of experiments.	Head above gate.	Velocity of wheel.	Mean velocity of wheel.	Ratio of velos. calling 4.44 unity.	Ratio of effect to power.	Mean ratio of effect to power.	Compar'n of ratios calling .811 unity.
		feet.	feet.	feet.				
Table first, gate *a*.	5, 11, 14	2.75	5.43			.834		
	33,37,40,45	1.25	4.88			.846		
	50	0.50	4.44	4.92	1.11	.872	.851	1.05
Table second, gate *b*.	3 & 8	2.75	7.59			.835		
	15	1.25	5.28			.839		
	22	0.50	4.65	5.84	1.31	.832	.835	1.03
Table third, gate *c*.	2 & 18	2.75	5.99			.811		
	5 & 8	1.25	6.15			.842		
	16	0.50	4.60	5.58	1.26	.831	.828	1.02

It appears from this comparison that the ratio of effect to power with the different gates, varies within the moderate limits of less than three per cent, being very little in favour of gate *a*. In fact the results are almost identical. This is not the case with the velocities, the consideration of which cannot, however, be conveniently introduced in this place.

The foregoing comparisons having been made with different widths of aperture, that is by taking a mean under each head, disregarding the variation in the quantity of water, they may be objected to as deduced from experiments not alike in every respect; for if the variation in the quantity of water produces any effect, these averages will be unequally altered by it. This reasoning is not applicable to any considerable degree, because the variation in the ratio of effect to power from the cause stated is small. To prove this position and to show the accordance of these mean results with single ones which are strictly alike in all the circumstances, the following table has been selected from tables first, second, and third. The arrangement of it is sufficiently explained by the headings of the different columns.

TABLE FIFTH.

Comparison of experiments similar in circumstances with gates a, b, and c.

Head above gate in feet.	Head and fall, in feet.	Width of aperture, in inches.	Gate *a*.		Gate *b*.		Gate *c*.		Ratio of velocities 4.44 being unity.			Ratios .814 unity.		
			Velocity of wheel in feet.	Ratio.	Velocity of wheel in feet.	Ratio.	Velocity of wheel in feet.	Ratio.	Gate *a*.	Gate *b*.	Gate *c*.	Gate *a*.	Gate *b*.	Gate *c*.
2.75	23.00	1.00	5.43	.839	7.66	.832	5.35	.814	1.22	1.73	1.20	1.03	1.02	1.00
1.25	21.50	1.00	5.28	.850	5.28	.839			1.19	1.19		1.04	1.03	
"	"	1.25	4.83	.845			6.20	.845	1.09		1.40	1.04		1.04
0.75	21.00	1.25			5.50	.836	4.77	.842		1.24	1.08		1.03	1.03
0.50	20.75	1.25	4.44	.872	4.65	.832			1.00	1.05		1.07	1.02	
								Mean	1.12	1.30	1.23	1.04	1.02	1.02

In these single results the ratios range from 1.00 to 1.07, the averages being almost exactly in accordance with the former conclusions. It follows, then, that *as far as regards the ratio of effect to power, gates a, b, and c, may be used in practice at the convenience of the mill-wright.*

We are now prepared to determine the mean ratio of effect to power in overshot wheel No. 1, twenty feet in diameter. This is done in the following table taken from tables first, second, and third, where the ratios under the different heads, with the three gates, are collected, and the means deduced.

TABLE SIXTH.

Overshot wheel No. 1.—Ratios of effect to power under different heads.— The power being calculated on the head and fall.

Head.	Mean ratio of effect to power, with gate			Mean.
	a.	*b.*	*c.*	
Feet.	Ratio.	Ratio.	Ratio.	Ratio.
2.75	.834	.835	.811	.823
2.25	.831			.831
1.25	.846	.839	.842	.842
0.75		.836	.841	.838
0.50	.872	.832	.831	.845
0.25	.819			

Omitting the last result in which the water was so low as to pass irregularly over the gate, the ratios vary from .823 to .845, or from 1 to 1.025. But two and a half per cent. of effect would, therefore, be lost in an overshot wheel of this size by varying the head from six inches to two feet nine inches. The lower heads give, of course, the best ratios, and leaving out of consideration the velocity of the wheel, are most advantageous.

The high results which these experiments prove may be obtained in practice from large overshot wheels, are worthy of special notice. With a head of .11 of the whole head and fall, (three inches in twenty-seven), which was the lowest used by Smeaton in his experiments, he obtained an effect of but .69 of the power. While in the experiments of the Committee with heads of 2.25 feet, for a head and fall of 22.50 feet, (.10 of the head and fall) and of 2.75 feet for 23.00, (.12 of the head and fall) we have ratios of .823 and .831.

It follows from these experiments that *in running a large overshot wheel to the best advantage, eighty-four per cent. of the power may be calculated upon for the effect.*

In regard to the effect of the quantity of water passing into the buckets of an overshot wheel with a given velocity, it is reasonable to conclude that under determinate circumstances it admits of being adjusted so as to produce a maximum effect. The annexed table will

show that in fact this is the case. It is selected from tables first and third, and contains the ratio of effect to power under given heads and openings.

TABLE SEVENTH.

Change of ratio by varying the quantity of water admitted to the buckets of wheel No. 1, *overshot.*

Width of aperture, in inches.	Ratio under head, in feet, of					Mean.
	2.75	2.25	1.25	1.25	0.75	
0.50	.829		.839			.834
0.75		.820	.850			.835
1.00	.839	.835	.850			.841
1.25	.834	.837	.845	.845	.842	.841
1.50				.838	.841	.839

The tendency to a maximum as the quantities are increased, by increasing the widths of the apertures, is not only seen in the separate columns but appears in the average, where it might be supposed that the introduction of the experiments with low heads would tend to raise the numbers so much as to make the small variation by quantity disappear.

The amount of increase, however, is shown to be too small to be regarded in practice, being probably less than one per cent. It may therefore be assumed *that within the limits of regular motion in the wheel, and waste from unduly filling the buckets, no diminution of effect will be experienced.*

In these experiments the areas of discharge for the water were varied from eight to twenty-four square inches, and the portion of the bucket which contained water to the whole capacity, in the case of the greatest proportion, was three tenths to one.

2. *The velocity of the wheel.*—The first question to be examined in this division of the subject is in reference to the relative velocities of the water and of the wheel, when the ratio of effect to power is a maximum. To determine which, the velocities of the water in the cases of maximum ratio given by the tables must be first ascertained. The velocity of efflux from the aperture in any particular case will be found by comparing the number of pounds of water discharged with the duration of the experiment. The discharge per second being thus known, in pounds, is converted into cubic feet and divided by the area of the aperture in square feet. In this way the numbers contained in in the third, eighth, and thirteenth columns of the annexed table, have

been found. For subsequent reference, a comparison has been made in this table of the theoretical discharges with those actually measured.

TABLE EIGHTH.

Quantities of water discharged per second, under the several heads, and with the gates *a*, *b*, and *c*, deduced from experiments giving the maximum ratio of effect to power. Collected from tables A, B, and C.

Overshot No. I.

Gate *a*.					Gate *b*.					Gate *c*.				
Head.	Width of aperture.	Velocity of discharge, per second.	Ratio of velocity to theoretical velocity.	Mean ratio.	Head.	Width of aperture.	Velocity of discharge, per second.	Ratio of velocity to theoretical velocity.	Mean ratio.	Head.	Width of aperture.	Velocity of discharge, per second.	Ratio of velocity to theoretical velocity.	Mean ratio.
feet.	in's.	feet.			feet.	in's.	feet.			feet.	in's.	feet.		
2.75	0.50	7.91	0.59		2.75	0.75	12.50	0.94		2.75	1.00	9.60	0.72	
"	1·00	7.23	0.54			1.00	12.20	0.92						
"	1.25	7.52	0.57	0.57					0.93					0.72
2.25	0.75	7.18	0.60											
"	1.00	7.15	0.59											
"	1.25	7.16	0.59	0.59										
1.25	0.50	6.53	0.73		1.25	1.00	8.00	0.89	0.89	1.25	1.25	6.57	0.73	0.73
"	0.75	5.51	0.61								1.50	6.57	0.73	
"	1.00	5.04	0.61		0.75	1.25	5.62	0.81	0.81	0.75	1.25	5.19	0.75	0.73
"	1.25	5.45	0.61	0.64							1.50	4.93	0.71	
0.50	1.25	4.06	0.72	0.72	0.50	1.25	4.48	0.79	0.79	0.50	1.50	3.99	0.70	0.70
0.25	0.75	3.54	0.88											
"	1.00	3.16	0.78	0.83										
Mean of 2.75,2.25,0.50,				0.63	Mean				0.85	Mean				0.72

A comparison of the quantities actually discharged with the theoretical discharges, shows a difficulty in obtaining the actual velocity of the efflux. The coefficient for the contraction of the vein by gate *a*, is very nearly that for a thin plate, while those for *b* and *c* show that they have acted in part as adjutages in modifying the discharge, although it is a fact that experiments made when the aperture was evidently filled were rejected. While the quantity of discharge is thus increased, the velocity of efflux is actually diminished. If then the impulse of the water and not the quantity delivered is the determining circumstance of the velocity of the wheel, and the retardation of the water should be considerable, the fact will appear in the sequel.

After leaving the aperture, the water is accelerated in falling until it strikes the wheel. To know where to assume the average point of impact it will be necessary to consider the motion of the wheel. The

water on entering an elbow bucket will first strike against the arm, then as the wheel revolves will meet the bottom of the bucket, or soling of the wheel, and so on until the next bucket present itself. After the water has struck the arm of the bucket it falls to the bottom, not having imparted all its velocity to the wheel by the impact. As the bucket fills, the distance through which the water falls will diminish.

The following approximate table has been calculated from the actual quantities of discharge per second under the different heads, and with different apertures, the known velocity and particular construction of this wheel.

TABLE NINTH.

Showing the relative proportions of the part of each bucket, which contained water, to the whole capacity of the bucket.

	Head.	Width of aperture.	Discharge per second.	Velocity of wheel per second	Time of passage of bucket.	Water received by bucket.	Portion of entire bucket w'h. is filled.	Mean ratio.
	feet.	inches.	cubic feet.	feet.	seconds.	cubic feet.	Ratio.	
Gate *a*, elbow buckets.	2.75	0.50	0.438	5.28	0.24	0.105	0.14	
	"	1.00	0.800	5.43	0.23	0.184	0.25	
	"	1.25	1.040	5.58	0.22	0.229	0.31	0.23
	2.25	0.75	0.597	5.21	0.24	0.143	0.19	
	"	1.00	0.794	6.01	0.21	0.167	0.23	
	"	1.25	0.991	5.50	0.23	0.228	0.31	0.24
	1.25	0.50	0.362	4.65	0.27	0.097	0.13	
	"	0.75	0.458	4.77	0.26	0.119	0.16	
	"	1.00	0.611	5.28	0.24	0.146	0.20	
	"	1.25	0.755	4.83	0.26	0.196	0.27	0.19
	0.50	1.25	0.564	4.44	0.28	0.158	0.22	0.22
	0.25	0.75	0.294	3.99	0.31	0.091	0.12	
	"	1.00	0.350	3.76	0.33	0.115	0.16	0.14
Gate *b*, elbow buckets.	2.75	0.75	1.040	7.52	0.16	0.166	0.23	
	"	1.00	1.360	7.66	0.16	0.218	0.30	0.26
	1.25	1.00	0.887	5.28	0.24	0.213	0.29	0.29
	0.75	1.25	0.777	5.50	0.23	0.179	0.24	0.24
	0.50	1.25	0.619	4.65	0.27	0.167	0.23	0.23
Gate *c*, elbow buckets.	2.75	1.00	1.083	6.85	0.18	0.196	0.27	
	"	1.25	1.320	6.62	0.19	0.251	0.34	0.30
	1.25	1.25	0.870	5.66	0.22	0.191	0.26	0.26
	0.75	1.50	0.856	5.66	0.22	0.188	0.26	0.26
	0.50	1.50	0.667	4.65	0.27	0.180	0.25	
	"	2.00	0.736	5.21	0.24	0.176	0.24	0.24
Gate *c*, centre buckets.	2.75	1.00	1.073	5.35	0.23	0.247	0.34	0.34
	1.25	1.25	0.909	6.20	0.20	0.182	0.25	
	"	1.50	1.090	6.10	0.20	0.218	0.30	0.27
	0.75	1.25	0.717	4.77	0.26	0.186	0.25	
	"	1.50	0.818	5.07	0.25	0.204	0.28	0.26
	0.50	1.50	0.661	4.60	0.27	0.178	0.24	0.24

From this table it appears that at the higher heads, 2.75 and 2.25 feet, the portion of the elbow buckets which was filled was .25 and at low heads .17. From these data it may be shown that if the water

were distributed with a surface parallel to the soling, the depth in the first case would have been .11 of a foot, and in the second .07. The water flowing towards the lower part of the bucket, ever occupied an average depth equal to that calculated, and the depth of the bucket being .60 ft., no sensible error will arise by taking .15 ft. from the distance between the aperture and the bottom of the bucket, in the higher heads, and .10 ft. in the lower ones to obtain the distance through which the water was accelerated after leaving the aperture.*

The same table shows that the elbow buckets used by the committee had a sufficient breadth of throat to receive the water without difficulty. The portion of the centre buckets occupied being, at a mean, very little greater than that of the elbow buckets.

In the table which follows, the approximation just referred to is applied. The head corresponding in theory, to the velocity of efflux from the aperture or virtual head, is first obtained. To this is added, for the higher heads, the distance from the aperture to the bottom of the bucket, obtained from tables A, B, or C, less .15, and for the lower the same distance less .10 ft. The velocity corresponding to the sum is that with which the water struck the wheel. The velocity of the wheel at the maximum is transferred from the tables first, second, and third.

TABLE TENTH.

Comparison of the velocity with which the water strikes the wheel with the velocity of the wheel.

Overshot No. I.

	Head.	Velocity of Water.	Virtual head.	Virtual head tog'th'r with constant.	Velocity of impact.	Velocity of wheel.	Ratios.	Mean ratio.
	feet.	feet.	feet.	feet.	feet.	feet.		
Gate *a.*	2.75	7.55	0.885	1.585	10.02	5.43	0.54	
	2.25	7.17	0.798	1.498	9.78	5.57	0.57	
	1.25	5.50	0.469	1.219	8.74	4.88	0.56	
	0.50	4.06	0.256	1.006	8.02	4.44	0.55	
	0.25	3.35	0.176	0.924	7.69	3.87	0.50	0.54
Gate *b.*	2.75	12.35	2.368	3.068	14.03	7.59	0.54	
	1.25	8.00	0.978	1.728	10.50	5.22	0.50	
	0.75	5.62	0.490	1.240	8.90	5.50	0.62	
	0.50	4.48	0.311	1.061	8.26	4.65	0.56	0.55
Gate *c.*	2.75	9.60	1.431	2.131	11.71	5.35	0.46	
	1.25	6.57	0.670	1.420	9.54	6.15	0.64	
	0.75	5.06	0.397	1.167	8.66	4.92	0.57	
	0.50	3.99	0.247	0.997	7.98	4.60	0.57	0.56

* This correction is not important, but as the calculations pertaining to it serve to show an important fact in regard to the due proportions of the buckets, it has been deemed worth while to produce them, and to show their application. The ratio of the velocity of the wheel to that of the water would be affected but .02 in .52, by assuming the bottom of the bucket as the place of impact.

The table just given developes this fact in regard to *the velocity of the overshot wheel*, namely, that it *bears a constant ratio, for maximum effects, to that of the water, this ratio being at a mean about .55, or nine-sixteenths.*

The ratios for both gates *b* and *c*, exceeding that for *a*, confirms, in a degree, the remark before made, that the velocity is checked in flowing from them.

The correspondence just shown, renders the determination of the head for an overshot wheel, to suit a fixed velocity, very simple. The depth of the bucket being the only variable quantity.

[TO BE CONTINUED.]

Blasting Rocks under Water by means of the Galvanic Battery.

At page 221, vol. xii, of the last series of this Journal, we published an article by Professor Hare, describing an apparatus for the blasting of rocks by means of galvanic ignition; and it will be seen, by the subjoined letter, that Captain Paris, a well known engineer and architect, of Boston, has applied the proposed means with perfect success, in blasting rocks under water. In the article by Dr. Hare, Mr. Moses Shaw, of Nova Scotia, is mentioned as having first suggested the idea of igniting the powder in blasting rocks, by the aid of the electric fluid. That gentleman had pursued the subject with much persevering industry, contending, at the same time, against pecuniary difficulties, and a want of those resources which science alone can supply, in the prosecution of such undertakings. He well merits, however, to have his name associated with those who have brought the matter to a successful issue.

EDITOR.

DEAR SIR,—Knowing the great interest you have always manifested in all engineering operations connected with the construction of public works, it affords me pleasure to communicate to you an account of the transactions within the past summer at this Navy-Yard, in blasting rocks under water, by means of the galvanic battery.

The application of this means to purposes of blasting, is somewhat novel, as you are well aware, and the account of Colonel Pasley's experiments in England has given to the public the first notice of its being thus employed. Since the blowing up of the wreck of the Royal George, it has been successfully used in England in blasting rocks and clearing harbors, rivers, &c. from obstructions: it bids fair to entirely supercede the old methods of blasting, both in civil and military operations, especially in the latter, where it becomes a tremendous agent for the instantaneous explosion of mines, &c.

In the detailed accounts of the experiments tried by Col. Pasley, it appears that at first, many difficulties were encountered; and the numerous failures seemed to forbid any hope of success in large operations, although the result of those on a smaller scale generally proved satisfactory. Perseverance, however, enabled the operators, after many trials, to render the explosion of the charge under water, as certain as by the ordinary methods on dry land; and the subsequent success in blowing up sunken wrecks, &c. at the bottom of the Medway river, and at Spithead, proved the utility of the means and amply compensated for the labour and expense incurred in the first attempts.

Our operations during the past season were confined chiefly to the construction of quay walls and the foundations of two launching ways, the whole of which were built of stone. The character of the bottom of the river where the work was laid, rendered blasting or other means necessary, before a proper surface for the foundation could be obtained; it was desirable to give it a slight inclination inwards, so that the face of each course of stone should lie somewhat higher than the inside, thus preserving a proper batter of the walls and rendering them perfectly secure. This bottom is a hard slate rock, and, with the exception of some level portions, extremely uneven, with slopes of almost every grade, generally in an outward direction from the shore. The depth of water in the line of the walls varies from fifteen to twenty feet at low water, and from twenty-five to thirty below the high tides. This depth of water added to a strong and variable current, caused me to anticipate much difficulty and great expense in all operations below its surface.

But we were fortunately provided with a fine diving apparatus, consisting of a cast iron diving bell and a powerful air pump attached. This apparatus was worked from a vessel of strong construction and light draught, fitted expressly for the purpose. A system of signals and messengers was established for communication between the workmen in the bell and those on board the vessel; by these means every want was speedily made known and answered. Four workmen, divided in two gangs were employed for working in the bell, which made four descents per day, occupying at each time two and a half hours, the two gangs alternately relieving each other. The bell was amply supplied with a constant stream of fresh air, and but two or three inches of water remained in it at its greatest depth, so that the men worked in a comfortable state, perfectly dry and with no more difficulty of respiration than on dry land.

In deciding upon the best means for preparing the bottom for the reception of the foundation of the walls, I was greatly at loss which to adopt. It appeared to me that in adopting the method practised

by Col. Pasley, great expense and difficulty would be incurred; and as it did not appear that this method had been employed in blasting the solid rock at the bottom of a river, in any of his experiments, I was somewhat apprehensive of its utility for operations of this kind, and whether the cost would justify the trial. In order to satisfy myself with regard to the expense of an experiment with the galvanic battery, I applied to Mr. Daniel Davis, Jr., philosophical instrument maker, of Boston, for the necessary information, when I was convinced that a very trifling expense would procure such a trial as would satisfactorily decide the merits of the apparatus. Mr. Davis kindly assisted me in making the experiments which were tried at the Navy Yard at Charlestown, and I had the pleasure of witnessing the most satisfactory results, and without hesitation determined to apply the means to the work in hand.

The galvanic battery which was constructed by Mr. Davis, was one of Doct. Hare's invention, of Philadelphia. It consists of two vessels or jars, each formed by two concentric cylinders of copper, admitting of a cylinder of zinc between. Two copper wires termed the conducting wires formed the medium by which the electrical fluid was communicated to the charge from the battery. These wires were closely wound with thread in order to prevent their coming in contact with each other, and both tightly covered with tape, and afterwards served round with twine, thus forming a single coil. At each extremity of the coil the wires were separated for a few inches like a fork. This form of the galvanic battery, termed by Doct. Hare, the "Calorimoter," is the most simple and portable of any that I have seen; its power for blasting gunpowder may be increased to any required degree, either by enlarging the size of the jars or increasing their number. We had, in addition to this apparatus, a simple contrivance for proving the charges of powder, which is termed the "Electrometer."

The charges used in blasting consisted of various quantities of gunpowder, according to the effect required, from four ounces to a pound. They were enclosed in perfectly air tight tin cannisters, the smallest being an inch and a quarter in diameter, and the diameter of the largest about two inches; the lengths of the cannisters were eight or nine inches. Two copper wires were introduced into the cannister about half way down, with the extremities connected by a fine platinum wire; the other ends of the wires projected twenty or twenty-five inches beyond the mouth of the cannister, which after being filled with powder was closed and effectually secured with a water-proof composition. It will be observed in thus preparing the charges that

the whole is completely air and water tight, and that no vent to the powder remains, an advantage of which I shall further speak.

The operation of blasting is carried on in the following manner: The hole in the rock for the reception of the charge is drilled to a proper depth by the workmen in the bell; the cannister is then inserted with the ends of the copper wires extending outside of the hole, which is then filled up or tamped with coarse sand. The ends of the conducting wires are then connected by means of clamps to the wires leading from the charge; the other end of the coil is then led up, as the bell is hoisted to the surface, to the battery, which in all our experiments was placed on a floating stage directly over the charge. The jars forming the battery are brought near each other, and their whole power concentrated by connecting them together with a short copper wire; the end of one of the conducting wires is then brought in contact with one pole of the battery, and the end of the remaining wire similarly disposed with the other pole, when the explosion instantly follows by the platinum wire in the charge becoming intensely heated as the electrical current passes through the conducting wires.

We made during the past season nine blasts, with but one failure, which was caused by the platinum wire in the charge becoming accidentally broken, so as to render the electrical circle incomplete; this probably occurred in tamping, an operation which must be conducted with care, as this accident is most liable to be incurred, of all others, owing to the extreme delicacy of the wire. The object of the electrometer is to detect whether this has taken place before the charge is inserted in the rock, and may always be ascertained by a simple trial.

It must be obvious to every one, at all experienced in blasting rocks, that this method has advantages in many respects over the old methods, both under and out of water. The danger of accidental explosions is entirely prevented; these occur for the most part in the old practice by carelessness, while in this, great care and nicety are required to produce the explosion. There is very little time required in charging, as the cannister is simply inserted in the hole and tamped with sand; the whole time occupied in this operation and making the connection with the conducting wires in the present cases rarely exceeded twenty minutes. There is great expense and trouble saved in the absence of the train or fuse, which was indispensable in the old methods, especially under water, where was always required a water-tight hose or tube leading to the surface, which was always destroyed by the explosion. Here nothing is lost or injured except the cannister containing the charge. The explosion of the charge is

reduced almost to certainty, and should cases of failure occur, it can be approached with safety, without the suspicion that fire may be near it. The most important advantage in an economical view, is that the effect of the charges is much greater than in the old way, in consequence of there being no vent-hole; the whole explosive force of the powder is thus gained, while by the old methods much of it is lost. Our smallest charges displaced a much greater quantity of rock than the same amount of powder by the old means, which we had opportunities of experiencing. With these advantages, this method of blasting places in our hands the most ample means of clearing harbours and rivers of rocks, &c. in any reasonable depth of water.

In using Doct. Hare's apparatus, it appeared that an important advantage was gained over that of Professor Daniell's, employed by Col. Pasley, inasmuch as a very troublesome arrangement, indispensable in the latter, was avoided. This consisted in not being obliged to insulate the conducting wires from the water, as in such a case the connection of the conducting wires with the charge must be made before the cannisters are placed in the rock; every portion, then, of the wires where the connection is made, must be covered with the water-proof composition. By Professor Daniell's apparatus, it appeared that water was a conductor, thus destroying the electrical circle, if any part of the conducting wires came in contact with it.

Though Doct. Hare's battery was known to Col. Pasley, it was not adopted in his experiments, the reason assigned being that "it did not appear that he had ever used it under water."

I have the honour, Sir, to be,

Your obedient servant,

ALEXANDER PARIS, Civil Engineer.

COL. S. THAYER, Boston.

Navy Yard, Portsmouth, N. H., Nov. 9, 1840.

An Account of the Establishment for the Manufacture of White Lead, from the Pulpy Oxide of Lead, under the Patent granted to Mr. G. F. Hagner.

At page 274, of the last volume, we published an article "On the manufacture of white lead from the pulpy oxide prepared by trituration," in which we intimated that we expected to obtain some further information upon this subject. The subjoined letter, from a gentleman who was a principal in the undertaking, affords this information; and the character of the writer for intelligence and integrity, is too well known to be strengthened by any thing that we could say. Patents have been obtained, within a few years, by persons

who appeared to consider the triturating process itself to be new, as described by them; the facts which we have before published, together with those detailed in the accompanying letter, must put this question at rest; and it will also appear that the proceeding in some other particulars was substantially the same with such as have been since claimed by others.

To the Editor of the Journal of the Franklin Institute.

Shamokin, 12th Month, 21st, 1840.

Respected friend.—A succession of engagements have prevented an earlier reply to the inquiries made by thee respecting what I know relative to the discovery of making white lead by attrition, I now offer, from recollection, the following facts, my papers relating to them, being in Philadelphia.

I spent the winter of 1817–18, in London, and there met, for the first time, with Geo. F. Hagner, of the county of Philadelphia. He informed me that he had discovered a method of making white lead by attrition, that he had obtained a patent for his discovery in the United States, and that he had come to Europe for the purpose of procuring patents in such kingdoms as he might think it his interest so to do; my belief is that he entered caveats, or took out patents, for England, Scotland, and Ireland. In the following spring, he went to the continent, and remained there for some time.

About this period, Jos. Richards, who had, for several years, been engaged in manufacturing white lead, by the old process, built a mill, and put up machinery, at the Falls of Schuylkill, for making lead by attrition; whether the plan pursued by him was identically the same as that patented and claimed by G. F. Hagner, I am unable to say, never having seen his works, the water power of his mill being destroyed, in common with all other power, at the Falls, by the dam at Fairmount. I did, however, see a portion of his machinery, which differed materially from that used and approved by G. F. Hagner.

Soon after I returned home from Europe, I met with G. F. Hagner, and was induced to invest a considerable sum of money in manufacturing white lead by his process. We commenced in the spring of 1820, in a small mill, on the west bank of the Schuylkill, below Flat Rock, but soon after removed to a mill built near the locks on the canal, at Manayunk. The first process was to melt the pig lead, and reduce it into very fine particles, as fine as gunpowder. The process by which this was done, was cheap and rapid, but as G. F. Hagner never patented it, and kept it a secret from the workmen, I do not feel at liberty to describe it; I may, however, mention that the lead was not dropped into water, as stated in an article of the September No. of

the Journal. The granulated lead was put into large cylinders made of wood, and lined with sheet lead. These cylinders were about six feet long, by four feet six inches wide at one end, and three feet at the other. The small end was open. They revolved on an axle passing through the centre. With the lead was put vinegar, or water, and as the liquid became thick with the white oxide, it was taken out and fresh lead and vinegar added. The white oxide was allowed to settle; was washed to rid it of the acid, then dried, and ground in oil, as usual. The article, as thus manufactured, had great specific gravity, covered well, and resisted the effects of sun and weather better than white lead made by the old process. It dried quickly, without the use of litharge, it was well adapted for outside use, but not for the interior of houses, as it became very yellow in confined rooms; on account of this property it was not liked, and we expended considerable money to overcome this difficulty. In the course of our experiments I deemed it prudent to consult our late worthy and esteemed friend, Wm. H. Keating, then Professor of chemistry, in the Faculty of Arts, in the University of Pennsylvania, who analyzed some of our white lead, and gave us his opinion respecting it. He had in his possession, at that period, an apparatus that had been used on the Brandywine, by a friend of his, in trying a set of experiments to produce the same result that we were trying to effect. This apparatus he lent us, and we used it at Manayunk.

After having spent many months, and undergone much labour of body and mind, and having also expended a considerable sum of money, we believed that we had arrived at a mode by which we could make a perfect article; but as we had not room enough to operate in the part of the mill we occupied, I sold out at Manayunk, and erected buildings at Norristown, adapted to our purpose, in which we could make two tons of white lead in every twenty-four hours.

In this new establishment, we put up the large cylinders before described, but did not depend alone on the white oxide made in them; all that was made in these was used by us; but our principal dependence was upon litharge. The litharge, or the white pulpy oxide, either together or separate, was run through a pair of mill stones, with distilled vinegar, and in this liquid state the ground material was passed through a set of tubes or cylinders connected by copper pipes. These cylinders were air tight, lay on their sides, and were fitted up with dashers much like a common butter churn. With the litharge and vinegar, was forced into the cylinder a large quantity of carbonic acid gas. These materials passed through eight cylinders with dashers, and into a ninth, without dashers; from this last cylinder the gas passed into the open air through a high copper tube, and the

liquid into tubs placed on the floor, so as to admit of the settling of the lead; these tubs were connected with tubes which allowed the vinegar to pass into a reservoir, to be used over again.

The lead was then washed to get clear of the acid, dryed, and ground, as usual. The white lead thus made, was a perfectly carbonated article, very fine and white. Its specific gravity was less than that of the best white lead made on the old plan, and hence there arose an opinion in the mind of the consumer, that it was adulterated. At the exhibition of the Franklin Institute, in the year 1826, I obtained the premium, in competition with the best lead there. The article we made was beautiful, and the arrangement as complete as any I ever saw.

In justice to Philip Mayer, a German, of considerable chemical and mechanical knowledge, I should say, we had his aid in this establishment.

In conclusion, I may state, we had the result of upwards of two thousand experiments, tried during a period of five years, and that finally we succeeded, so far as to produce a truly excellent article. To give a description of our numerous experiments, would fill a number of the Journal.

In this letter, I have endeavoured to give the kind of information which I believe was desired by thee; if not, please inform me, and I shall be glad to afford thee any other in my power.

I am, very respectfully, thy friend,

SAMUEL R. WOOD.

In the foregoing letter, the writer mentions that the lead was granulated by a process which Mr. Hagner did not communicate to his workmen, and which he, therefore, does not feel himself authorized to disclose; we, however, are at liberty to offer our conjectures respecting the manner in which the granulation spoken of was effected, and which, we suppose, was upon a principle well understood by chemists, and others. We apprehend that the lead, in a fused state, was submitted to continued agitation in a revolving iron cylinder, or other suitable vessel, the agitation being continued until the metal had set, or lost its fluidity, when it would be found in the state of fine grains, as above described.

On Indigo.

Part 1st. The constituents of ordinary Indigo.—Of all colouring materials employed in dyeing and printing on vegetable or animal fibre, indigo claims pre-eminent rank, whether in regard to its beauty,

durability, or the variety of methods of application, and indeed in respect to its fastness or permanency, it is unequalled by many, and scarcely excelled by any of the colours derived from the mineral kingdom, when exposed to ordinary atmospheric agents. These considerations, and the fact of its very extended employment in colouring processes, point it out as worthy of peculiar attention and close investigation, in order to a thorough knowledge of its characteristic properties, and chemical relations, which, although not sufficiently examined, have nevertheless been rendered more intelligible, chiefly by the experiments of Berzelius.

In the state in which it occurs in commerce, it has long been known to be composed of a blue colouring matter, with various other ingredients, which were very imperfectly understood, until Berzelius proved that it contained four principal ingredients, together with small quantities of others. These are indigo-gluten, indigo-brown, indigo-red, and indigo-blue.

1. Indigo-gluten is obtained from the indigo of commerce, by treating it in fine powder with dilute sulphuric acid, which extracts it, together with salts of lime and magnesia. The insoluble remainder is boiled several times with water, which takes up more gluten than the acid water. The solution is saturated by carbonate of lime (chalk or marble), filtered, evaporated to dryness, and treated with alcohol. By evaporating the tincture to dryness, the gluten remains as a yellowish, or yellowish brown, transparent and shining varnish. In its behaviour towards reagents it resembles gluten, differing from it by its solubility in water, and its want of adhesiveness; it differs from vegetable albumen by its solubility in alcohol, and its not coagulating by ebullition.

2. Indigo-brown is obtained by treating the insoluble remainder after extracting the gluten by a concentrated solution of caustic potassa, with the assistance of warmth. The mass becomes instantly black, and swells up to a porous paste, in proportion as the brown colour dissolves. It is diluted and filtered, and the filter slightly washed. The solution neutralized, and then acidulated by sulphuric acid, suffers the brown to precipitate, which may then be washed. As it still contains a portion of indigo blue, it is dissolved in carbonate of ammonia, evaporated to dryness, dissolved in a little water and filtered, by which operation, the blue, with a portion of the brown, remains on the filter. It is exceedingly difficult to obtain it perfectly free from other substances, so that it cannot be said that we understand the nature of the pure brown substance. In its purest form it is a transparent, shining, brown varnish, slightly soluble in water, with neither an alkaline nor acid reaction. It combines eagerly with

acids, forming combinations, which are difficultly soluble in water. It unites so powerfully with alkalies, that the resulting compounds, although soluble in water, give no alkaline reaction with reddened litmus paper.

3. Indigo-red is obtained by boiling the remainder from the preceding operations, with alcohol of 0.83. Being difficultly soluble in alcohol, it is requisite to submit the residue to repeated boilings. After some time, the red solution passing through the filter, assumes a blue colour, from the presence of indigo blue. When the alcoholic liquid is concentrated by distillation, a blackish brown powder deposites, which, separated by filtration and washing, is indigo-red. By solution in alcohol or ether, and spontaneous evaporation, it remains as a dark red powder. It is insoluble in water, alkali, or dilute acid. Concentrated sulphuric acid dissolves it with a dark yellow colour, and if wool be placed in the diluted solution for several hours, it decolourises it, while the wool receives a colour varying from a yellowish brown to red. Chlorine water renders indigo-red yellow and soft, like wax, but after exposure to air, it assumes its original character.

4. After the three preceding substances are separated, the indigo-blue which remains is not absolutely pure, but may be rendered so by the following treatment. It is mingled with quick lime, (about twice the weight of the crude indigo) which is slacked to a powder immediately before its employment, put into a flask capable of containing one hundred and fifty times as much water as indigo, the flask is nearly filled with boiling water, and shaken. Sulphate of iron (copperas) is added (about two-thirds the weight of the lime) in fine powder, or dissolved in a little boiling water, the flask corked tightly, and well shaken. It is suffered to stand a few hours in a warm place, when the liquid assumes a lemon or dark yellow colour, in proportion to its concentration. As soon as the liquid has settled, the clearer portions are drawn off, and the remainder filtered through paper. The indigo blue, separating from the liquid when in contact with the atmosphere, carries down with it a portion of the foreign substances, an inconvenience easily obviated, by pouring the yellow liquid into dilute muriatic acid, which retains them in solution. The precipitate is well shaken until it assumes a full blue colour, then thrown on a filter and thoroughly washed. After it becomes dry, it is no longer of a blue colour, but has a shade of purple, and by friction exhibits a metallic lustre resembling that of copper. Hence the strength of the purple indicates, in some measure, the amount of blue in raw indigo.

Indigo-blue, in its pure form, has neither taste nor smell, exhibits

neither the reaction of an acid nor a base, and in short, is one of the most indifferent substances in its chemical relations. It burns, with difficulty, in the open air, with much smoke, and leaves a charcoal which burns with difficulty. If heated in a close vessel, without the access of air, it is converted into a purple vapour, which is gasiform indigo-blue, and condenses on the cooler portions of the vessel in crystalline scales, of a purple colour and metallic lustre. A considerable quantity of the blue is decomposed by the operation. The same crystals may be obtained from commercial indigo, but they are rendered impure by the sublimation of indigo-red. To perform the operation on a small scale, it is only necessary to place a cone of strong brown paper over a slightly concave tin dish of two or three inches diameter, and heat the latter over a lamp until the paper begins to brown, which heat is maintained until the greater part of the indigo is sublimed. The interior of the cone will be thickly coated with crystals, which can be purified, if requisite, by repeated boiling in fine powder with alcohol, which removes the red.

Indigo-blue is insoluble in water, alcohol, ether, olive oil, or spirits of turpentine. It is not affected by dilute acids, nor caustic alkalies. Chlorine instantly decomposes it, and renders it yellow. It is readily deoxidized by substances which have a strong affinity for oxygen, provided an alkali or alkaline earth be present, in which case the reduced indigo combines with the strong base. It is dissolved by concentrated sulphuric acid, but changed in a very remarkable manner. It is farther decomposed by nitric acid, giving rise to new and singular products. These chemical relations of indigo will occupy our attention in the succeeding part of the essay.

It appears, therefore, from the preceding, that there are four principal organic constituents in indigo, beside others in smaller quantity. Of these, the blue rarely attains 50 per cent. of the weight of the raw material; the red and brown are each present in larger proportion than the gluten. Beside these, there are mineral substances contained in it, either accidental or adulterations, such as silica, lime, magnesia, oxide of iron, alumina, potassa, and a little phosphoric acid.

Civil Engineering.

Letters from the United States of North America on Internal Improvements, Steam Navigation, Banking, &c., written by Francis Anthony Chevalier de Gerstner, *during his sojourn in the United States, in* 1839.

(Translated from the German, by L. Klein, Civil Engineer.)

Letter VIII.

(Continued from page 82.)

6. *Cost of Running Steamboats.*

The expenses incident to the management of steamboats, consists in the salaries and wages of the individuals employed, the cost of fuel (wood), of the victuals for the cabin passengers and crew, and in the cost of repairs of the boat and engines.

I have mentioned, under No. 4, the extraordinary rise in wages, which took place during the last few years; the cause of it lies principally in the considerably increased number of steamboats, and the want of useful individuals, as also in the universal rise of prices of all articles in the United States. The payments to the officers and crew of the "Franklin," are, per month, as follows, viz:

1 Captain and 2 clerks,	$200
2 pilots,	200
2 engineers and 2 assistants,	250
2 mates,	80
1 carpenter,	30
2 cooks,	80
1 steward and 6 waiters,	140
1 chambermaid,	20
10 firemen,	200
6 common labourers,	120
38 persons, total,	$1320
Add for 785 cords of wood, and a few tons of coal,	1775
" provisions for 62 cabin passengers, and 38 men belonging to the boat, together for 100 persons,	1400
Total expenses, without repairs,	$4495

or nearly forty-five hundred dollars per month. During nine months in the year, the boat makes daily, a trip of one hundred and fifty miles, together, forty thousand five hundred miles per year; during the remaining three months, she is laid by, on account of the low

stage of the water in the river. She then is newly caulked, painted, and receives all the necessary repairs. The latter amount, with a new boat of this class, to not more than three thousand dollars in the first year, to which an amount has to be added for general depreciation, which is considerable. The timber of which the vessels are constructed here, is grown so fast, under a warm climate, that a vessel seldom lasts over six or seven years; but steamboats of the first class are used only four years, and then sold; the new proprietor continues to employ the boat for a few years longer, but her voyages are not so certain. Twenty-five per cent. of the original cost must therefore be taken as the amount for depreciation, in the first year, which makes seventy-five hundred dollars for the steamboat "Franklin;" at the end of the first year the value of the boat is therefore only twenty-two thousand five hundred dollars. In the second year, twenty-five per cent. of these twenty-two thousand five hundred dollars, or five thousand six hundred and twenty-five dollars are taken for the general depreciation; but the repairs in the second year amount to so much more, that their cost, together with the sum for general depreciation, is again equal to ten thousand five hundred dollars, as in the first year. The same calculation is applicable for the third and fourth year, after which, the value of the boat remains only nine thousand four hundred and ninety-two dollars, for which amount it is then sold.

We have, therefore, the following, as the yearly expenses for the steamboat "Franklin."

Current expenses during 9 months running time,	$ 40,500
During the remaining 3 months, the salary of the Captain and clerks, who remain on the boat, while the others are dismissed, amounts to	1,000
Repairs and general depreciation, - -	10,500
Insurance, 7 to 9 per cent. on three-fourths of the value, to which steamboats can only be insured,	1,350
Sundry small expenses, - - -	1,150
Total, - -	54,500
If from this sum be deducted the expenses for boarding the passengers and servants, say about	14,000
There remain as the expenses for running the boat alone,	$ 40,500

As this steamboat peforms during nine months, daily, one hundred and fifty miles, or in the whole, forty thousand five hundred miles, the expenses for every mile the boat travels, amount to one dollar.

On the other side, the revenues of this boat are, at an average, for each trip, of one hundred and fifty miles:

From 62 cabin passengers, at $4, - -	$248
" 63 deck passengers, at $1, - - -	63
125 passengers, at an average, per trip.	
For 25 tons of goods, at $3, - - -	75
" transportation of U. S. mail, - -	4
Total, -	$390

The amount of four dollars, received for transporting the mail one hundred and fifty miles, is, here, very small; the reason is, that the public prefer the mail boats to all others, on account of their safety and punctuality, in consequence of which, steamboat proprietors contract for the carrying of the mail even at the very lowest prices. The income of three hundred and ninety dollars per day, gives, for the nine months, one hundred and five thousand three hundred dollars, which, compared with the expense of fifty-four thousand five hundred dollars, shows an annual profit of fifty thousand eight hundred dollars. As the "Franklin" has only cost thirty thousand dollars, we see what an enormous profit those steamboats yield in America, which are frequented by a sufficient number of passengers.

The steamboat "Ambassador," the tonnage of which is twice as great as of the "Franklin," commenced her trips late in the Fall of 1837, and made, in that year, four voyages from Louisville to New Orleans, each of fourteen hundred and fifty miles, and four voyages back, together, therefore, running a distance of eleven thousand six hundred miles. The monthly expenses were eighty-five hundred dollars, which gives, for three months, twenty-five thousand five hundred dollars, or, per mile of travel, two dollars and twenty cents. In the year 1838, the "Ambassador" made ten trips from Louisville to New Orleans and back, and performed, therefore, twenty-nine thousand two hundred miles, within the period of eight months, the trips having been discontinued during four summer months, on account of low water. The total expenses for the whole year amounted to something over fifty-eight thousand dollars, which gives two dollars as the expense for running one mile. The salaries upon this boat amount, in consequence of her large size, and the long trips, to much more than upon the "Franklin," and are as follows, viz:

1 Captain receives, per year, - -	$2,000
1 first clerk, - - - -	1,200
1 second clerk, $50 per month, therefore in 8 months,	400
1 bar-keeper, $45 " " "	360

2 pilots, each $300 " " " both,	4,800
2 engineers, each $150 per month, out of which he has to pay his assistant; both in 8 months,	2,400
2 mates, one 75, and one $50 per month, therefore both in 8 months, - -	1,000
1 ship carpenter, $60 per month, therefore in 8 months,	480
2 cooks, one 50, the other $30 " " both,	640
1 steward, $85, and 6 waiters, each $25, all in 7 and 8 months, - - - -	1,880
1 chambermaid, $25, and one washer woman, $20 per month, both in 8 months, - -	360
16 firemen, each $35, all in eight months,	4,480
8 common labourers, each $25 per month, all in 8 months, - - - - -	1,600
48 individuals receive, in total, - -	$21,600

As they have, at the same time, free board on the steamboat, it is evident that the expenses for the persons employed on the boats, are much larger here, than in any part of Europe. The above stated expense of two dollars per mile of travel, includes the cost for board of the passengers, but at the same time, no sum for general depreciation has been taken into account. These amounts will very nearly counterbalance each other, and therefore we may, on this boat, as well as on other first class steamers of four hundred to five hundred tons burden, take the expense, for every mile of travel, at two dollars.

The "Ambassador" carried, in 1838, at an average, one hundred cabin passengers, each of whom paid fifty dollars per passage up, and forty dollars per passage down the river, and one hundred to one hundred and fifty deck passengers, who paid, in part, five, and in part, eight dollars each; finally she carried, generally, two hundred tons of goods up, and three hundred tons down. The receipts, per trip, of fourteen hundred and fifty miles, were frequently seventy-five hundred dollars, while the expenses did not amount to more than twenty-nine hundred dollars, leaving, therefore, a very considerable net profit. On her trips, in 1839, the "Ambassador" averaged only, up to the month of June, sixty-five cabin passengers per trip, but nevertheless, the boat will again give a handsome profit.

The steamboats "Franklin" and "Ambassador" belong, as I observed, to the most elegant, and charge, therefore, highest; boats of a cheaper construction, and less elegant, with their crew not so well paid, incur much less expenses; and we find boats of two hundred and more tons, on which the expenses, per mile of travel, are only fifty cents. If, therefore, these boats only carry thirty-four passen-

gers at an average, each paying one and one half cent per mile, the expenses are already covered. Should the number of passengers be less, or the expense of running greater, the charges for transportation must be increased.

The steamboats between Wilmington, N. C. and Charleston, S. C., which run one hundred and sixty miles along the sea coast, performed, from the 1st of June, 1838, to the 1st of February, 1839, in the whole, two hundred and ninety-seven trips, and carried four thousand and seventy-one through passengers, and twelve hundred and twenty-five way passengers; the number of passengers, per trip, was, therefore, at an average, only eighteen, and still the company does a good business, because the passengers pay five cents per mile, and the steamboats carry goods, and the mail besides. It has been calculated, that a mile of travel, of these boats, after deducting the expenses for victuals, &c. for the passengers, and without taking into account the general depreciation, costs only fifty-four cents, and therefore eleven passengers will cover the daily current expenses.

The steamboat "Champion," of two hundred and forty tons burden, which makes regular trips between Pensacola and Mobile, performs daily, ninety-eight miles, and the current expenses, per day, amount to one hundred dollars, including the passengers' board; each passenger pays ten dollars for the passage, or ten cents per mile, and the average number of passengers, per day, is only ten; the receipts are, therefore, just sufficient to cover the current expenses.

7. *Comparison of the Cost of Transportation in Steamboats with that upon Rail Roads.*

If we compare the total yearly expenses on the American rail roads, with the number of miles traveled by all the trains during the same period, we find, as an average, that the expenses for every mile a rail road train travels, amount to one dollar; the same, as I have shown, is the cost of running a steamboat of two hundred or three hundred tons, one mile. It is surely a remarkable result, that the travel of a steamboat of two hundred feet in length, costs just as much as the running of a locomotive engine with a train of carriages, of nearly equal length; the speed of the rail roads, however, is somewhat greater than that of the steamboats, the former being twelve to fifteen miles, while the latter, upon the Ohio and Mississippi, will average only twelve miles. If the steamboats carry one hundred or more passengers, per trip, they can afford to take only two cents per passenger, per mile, while the average charge upon rail roads, is five cents; but if only few passengers are carried by steamboats, the price must be increased, and be, as we have seen, sometimes, even as high as

ten cents per mile. Upon the American rail roads, the average number of passengers in a train, is only forty, the charges, per mile, can, therefore, not be less than five cents, in order that the gross income, for every mile, performed by the train, may be two dollars, while one hundred passengers, at two cents per mile, upon steamboats, will give the same gross income (two dollars,) per mile of travel. Every thing depends, therefore, on the number of passengers; if this is great, steamboats and rail roads will pay well; if it is small, both must fail.

Steam navigation has, in every case, the advantage, that it allows or even invites competition and opposition; because hundreds of boats, belonging to as many different proprietors, may navigate the same river. Upon rail roads, on the contrary, the danger would be too great if the same course were allowed, and, therefore, the vehicles of only one company, which, in this manner, exercises a monopoly, are always running. It is owing to the competition of the American steamboats, that passengers are now carried at one-third of a cent per mile, and these low charges have alternately effected the enormous increase of the number of passengers; because passengers will now go round some hundred miles, to reach, for instance, the Mississippi, upon which to continue their journey. It is, in fact, incomprehensible, that on no rail road in America, the trial with low charges has been made; there are only some opposition lines, as between New York and Philadelphia, to be met with.

There is, however, a case where rail roads must be preferred to steamboats, let the number of passengers be large or small. This case will take effect in a few years, with two long rail road lines, now constructing in America. The one goes from New Orleans to Nashville; twenty miles of it have already been completed, over a swamp of unfathomable depth, upon which the whole track is floating, and by this construction alone is distinguished from other rail roads. The length of this road will be from New Orleans to Havanna, on the Tennessee, four hundred and thirty-four miles, while the distance to Havanna, by the Mississippi and Tennessee, amounts to more than three times as much. The other rail road, of one hundred and fifty-six miles in length, will extend from Pensacola to Montgomery, and be constructed in opposition to the steam navigation upon the Alabama river, between Mobile and Montgomery, which is three times greater in extent. In both cases it is certain that a road of one third the length will be preferred by the traveling public, even if the charges upon the steamboats should be one third or one fourth the price per mile.

8. *Steamboat Explosions and their Causes.*

In the official report from the Secretary of the Treasury, dated 13th of December, 1838, it is stated, that since the introduction of steam

navigation, up to the summer of 1838, or during twenty years, two hundred and sixty steamboats, with about two thousand passengers, have perished; this would give, per year, thirteen steamboats, (at an average) and one hundred passengers, which were lost. This loss cannot be regarded as so very considerable, considering that the United States now contain sixteen millions of inhabitants, and that certainly a far greater number of persons are killed upon roads; the explosions of steamboats, which are always described in every paper, with all their horrors, have nevertheless—not in America, but in Europe—greatly excited the public mind. Every traveler has it here in his power, to inform himself of the quality of the boat, and of her passages, before he takes his passage in the same, and with the large competition existing upon those rivers, he is always able to find boats upon whose safety he may rely. As a rule it may be taken, that the boats which have higher charges, are more safe than those which carry cheaper; and with a little precaution, and some more expense, therefore, we may trust ourselves in American steamboats, in which I have traveled myself already some thousands of miles, with the fullest confidence. It is, however, of interest, to know the causes of the disasters.

a. The greatest number of accidents happen upon the Mississippi and Ohio rivers, where the steamboats continue their passage day and night, from New Orleans to Pittsburgh; the length of this voyage is two thousand miles, and including the stoppages, necessary for taking in wood, and for landing and taking passengers on board, the trip is made in ten days up, and six or seven days down the river. In the first case, the engines are, through two hundred and forty hours, constantly at work, during which time the boilers are incessantly heated, though the same is still more the case with the engines in manufactories, and in the Atlantic steamships; it must be considered here, that Pittsburgh lies ten and one half degrees further to the north than New Orleans, and it requires a good health, to support the enormous difference in the temperature of the two cities; it becomes evident that the engineers superintending the engines cannot afford to give the same the required attention, and explosions must, consequently, become more numerous.

b. Many accidents happen by "snags" and "sawyers," so called. They are trees torn away from the banks of the river, which get fast with their roots at some point, and remain in positions most dangerous to the steamboats. Whole islands are sometimes formed by such floating trees. For removing these obstructions, particular machines have been invented, and are constantly employed upon these rivers.

c. The Americans are, as is known, the most enterprizing people in

the world, who justly say of themselves, "*we go always ahead.*" The democrats, here, never like to remain behind one another; on the contrary, each wants to get ahead of the rest. When two steamboats happen to get alongside each other, the passengers will encourage the Captains to run a race, which the latter agree to. The boilers, intended for a pressure of only one hundred pounds per square inch, are, by the accelerated generation of steam, exposed to a pressure of one hundred and fifty, and even two hundred pounds, and this goes sometimes so far, that the trial ends with an explosion. Seldom they have here, as they do in Europe, fixed in the boiler, a plate of a composition which melts at a certain degree of heat, and the fire becomes extinguished by the water. The races are the causes of most of the explosions, and yet they are still constantly taking place. The life of an American is indeed only a constant *racing*, and why should he fear it so much on board the steamboats?

d. In order not to lose too much time, wood is taken in only every twelve hours, the quantity they take, is, for large boats, thirty cords, or three thousand eight hundred and forty cubic feet. As generally hard wood is used, the additional load which the boat receives at once, and on its fore end, amounts to about eighteen hundred cwt., and in consequence thereof, the boat touches the bottom, sometimes, on the flat banks. The taking in of wood lasts one hour, during which, the fire is constantly kept up, and the steam attains a very high pressure, necessary, sometimes, to bring the boat afloat. At the same time, they often neglect to pump the necessary supply of water for the boilers, the iron in the flues becomes bare and red hot by the action of the flame, and when at the starting, the water again fills the boiler, the steam is so suddenly generated, that an explosion is the consequence. Although it is generally known that most explosions occur when the boats start, after having got their supply of wood, the thoughtless travellers remain, notwithstanding, on the fore part of the boat, where they are most exposed.

e. During the nights, it sometimes happens that in the windings of the river, two boats going at a great speed, meet each other, and by the concussion, the weaker boat instantly sinks.

f. I have observed already, that there are only two pilots upon each steamboat, which do their service alternately every four hours, but remain on board for the whole voyage, from New Orleans to Pittsburgh, of two thousand miles. It has never been the practice here to take new pilots from station to station, and the consequence is, that the pilots, not acquainted with such an extent of river, which, at the same time, is subject to so frequent changes, often run aground, and

that then the engineer, by using steam of too high a pressure, exposes the boat to explosions.

At a closer examination of all the causes of steamboat disasters, here we find that they all have their origin in neglect and imprudence. The rapid increase in the number of steamboats, has created such a demand for engineers and pilots, that the able individuals are by far not sufficient, and ignorant persons, not knowing the nature of the dangers, often manage the boats, and it is rather surprising that not more accidents occur. None of the causes which lead here to accidents, exist in Europe; in particular, would the known cautious temper of my German compatriots be sufficient to guard them from disasters of this kind. It is to be regretted, that steam navigation was carried on in America five years before it was successfully tried in Europe; it would be still more to be regretted, if at present, when in twenty years, with an expenditure of forty-five millions of dollars, the Americans have acquired such a mass of experience, and brought steam navigation to such a high degree of perfection, we were still to hesitate, in Europe, to adopt the American plan of construction. The steam navigation companies in Europe ought to compare the data given in this letter with the rate of wages and other prices in Europe, calculate, hereafter, the prices of transportation of passengers and goods, compare the same with their actual prices, and they will see the advantage which would result to them by the adoption of the American system.

[TO BE CONTINUED.]

Description of a new form of Edge Rail, to be called the Z rail, with its supports, fastenings, &c.—Making with it a part of a railway track of a new construction—With estimates of the strength and stiffness of the rail, &c.—and of the cost of the track—and a comparison of it in these particulars, with other forms of railway.

The track now described, will consist of the longitudinal under-sills, (a, a) 3×10 inches in the section, with cross ties (b, b) $3\frac{1}{2} \times 6$ and 7 feet long, placed upon them at intervals of three feet from centre to centre, and upon the cross ties notched one inch deep to receive them, will rest the string pieces (c, c) (of the trapezoidal section shewn) three inches wide at top, five and three-eighths at bottom, and five inches deep. A treenail one and a quarter inches diameter, is driven vertically through the three timbers at each cross tie, excepting the ties on which the string pieces join, where there are two treenails of one inch diameter. Both under-sill and string piece are twenty-one feet long, and break joints with the rail, (also twenty-one feet

long) and with each other. The section of the rail (d, d) resembles the letter Z, the head or upper table being turned to the one side of the stem, and the foot or lower table to the opposite side. The rail is placed against the inner side of the string piece, with the upper table lapping over the upper and inner edge of the string piece, and thus bearing on the *top* of the latter; and the lower table resting upon the cross ties, notched down three-eighths of an inch to receive it. A continuous top bearing on the string piece, and detached bottom bearings on the cross ties, are thus obtained. The rail is held against the upright inner side of the string piece by horizontal screw bolts (e, e) every three feet, which pass through the stem of the rail about midway between its top and bottom, and through the string piece; the head of the bolt bearing against the rail, and the nut, with a thin washer, against an open morticed seat in the outer slope of the string piece. These bolts (being nine to each bar of twenty-one feet) are placed at points midway between the cross ties, excepting the two in each bar at its end, which come over the cross ties on which the joints of the rail occur. The rail is further confined latterly at its foot, by the shoulder of the notch into which it descends, and also held down by a hook headed spike (f, f) driven vertically into each cross tie. At each joining of the rails, a cast iron joint plate (g, g) is let into the cross tie, to increase the bearing of the rails at these weaker points; this plate having on the outside a ledge to confine the feet of the rails, and two holes in it to permit the spikes lapping over them, to be driven downwards into the tie. The track thus constructed, will rest on a bed of broken stone, sand or gravel ballasting, ten feet wide at bottom, eight feet at top, and twelve inches deep, which will be filled up to the top of the cross tie, and one inch above the bottom of the string piece, and leave a depth of five and a half inches below the under sill for drainage, &c.

The rail is intended to weigh forty-five pounds per yard—its whole depth is five inches, thickness of stem nine-sixteenths of an inch—top bearing for the tread of the wheel one and a half inches, total breadth of upper table two and one-eighth inches—breadth of bearing of upper table on the string piece one and a half inches—breadth of foot inclusive of stem one and nine-sixteenths inches—the whole breadth of the upper and lower bearing surfaces three and one-sixteenth inches—bolt hole in the stem five-eighths of an inch diameter.

The proposed rail, and the structure of which it is a part, will admit, of course, of a variety of proportions. The forms and sizes of the several parts shewn in the preceding description and annexed drawing, are considered suitable and sufficient for a track intended for the heaviest tonnage and highest speeds. It is hardly necessary to say,

that the rail and its fastenings, in combination with the string piece and cross tie, form the only subjects of claim to invention; as the under-sill, ballasting, attachment by treenails, and even the trapezoidal form of the string piece (for economy of timber) are none of them new elements of the railway structure.*

The following is a brief enumeration of the particulars in which the undersigned considers his new rail an improvement upon the previous forms of the edge rail:

1st.—The lateral support given by the string piece to the rail, aided by the lateral strength given to the stem of the latter by the foot or lower web, permits the bar to be made thin and deep without the danger to which the stem of the T rail is subject, of buckling, or bending sidewise, under vertical pressure. Greater strength and stiffness is thus attained in the Z rail, with a given weight of metal, than in the plain T rail—and also than in the H rail, or Bridge rail; for in both of the latter sections, the width necessarily given to the base, for stability of position on its support, prevents the extension of the depth of the bar, sufficiently for the attainment of the strongest and stiffest form.

2d.—The mode of connection between the Z rail and its string piece, makes the latter supply the place of the heavy and expensive chair demanded by the T rail, while the Z rail still enjoys (and in a still greater degree than the T rail,) the superior strength and stiffness due to the *depth* of its section.

3d.—The same mode of connexion gives a continuous support to the upper table, which is not had by any other form of section. And this support not only extends the bearing surface on the wood, but immediately upholds, by an elastic cushion, that part of the head which, in the T and H rails, is so subject to crush, split off, and wear away under the wheels; a defect of these sections which will, it is believed, occasion ultimately their entire disuse.

* The rail as shown in the drawing, has a slope given to the under side of the upper table, in order to make it a little stronger in its connection with the stem. This makes a corresponding slope in the part of the top of the string piece, forming the seat of the rail. The inclination (though not at all essential to the plan,) is not enough to do any *harm;* as the *friction* of the wood and iron would suffice of itself to prevent *sliding*. The sloping seat of the rail may be easily and quickly prepared, and the corner of the string piece rounded, by a planing tool with a properly shaped cutter. It is well known to be necessary to dress (generally with an adze) the top of the string piece for the common plate rail, to amend imperfect sawing. The string piece of the Z rail will be readily sawed into its trapezoidal form at the mill. The open mortice forming the shoulder of the nut of the screw bolt, will be cut so as to *drain itself* of water falling into it. The treenail head may be caulked and pitched, to keep the water out, or driven obliquely so as to put its upper end under the top of the rail. In other details of construction, improvements may perhaps be made upon the plan now presented, retaining its general features.

4th.—The position of the rail on the *inside* of the string piece, makes the resistance of the rail to the outward lateral thrust of the flanges, as great as that of the string piece itself, a result which cannot be obtained so simply, effectually and economically, by any of the modes of fastening the rail on the *top* of the string piece, which must be employed with the H, or Bridge sections. The push of the flange against the rail, it is well known, is *the* force to be provided against, and this provision is made in the Z rail by the mere effect of its peculiar form; while other rails must be kept laterally in place by auxiliary attachments of iron, the bearing surfaces of which being individually small, must be multiplied expensively and injuriously to the wood, by wounding it at their points of insertion. The fastenings which attach the Z rail to the string piece, are subjected to little or no strain by the side action of the wheels, and are therefore left to the sole duty of maintaining the contact of the bar with its supporting beam, for the preservation of the joint action of the two in resistance to vertical pressure, and securing the correct *line* of the road.

5th.—The attachment of the rail to the string piece by a number of bolts passing through both, efficiently resist the tendency to endwise movement in the rail, the prevention of which has heretofore been so imperfectly guarded against. The contraction and expansion of the bar will be provided for, by the elastic yield of the wood at the bolt holes.

6th.—The *lining* of the inner edges of the rails at the joints, and the springing of the bars to, and their maintenance in, the curve of the road, will be effectually secured by the horizontal attachments of the rail and string piece. The importance and the difficulty of these adjustments must be acknowledged. The difficulty of making the tops of the bars fall in the same horizontal plane, is occasioned by the unavoidable differences in their *heights*. The simplest and best way of compensating these discrepancies is, probably, to raise by a detached elevation, the part of the cast chair or joint plate on which each of the uniting rails is to rest, and then the highest of the two bars can, by a proper tool, have its seat reduced by the amount of the excess in its height. This compensition will be required for the Z rail as for all edge rails. But the lateral adjustment of the rails to a line at the joints will, in the Z rail, be effected simply by the screwing of the stem against the string piece; for after this is done, the break, if any, which may show itself in the line of the inner edges, must be produced by a difference in the thickness of the slender stems of the two contiguous rails, which (unlike the variation in their heights) must be inappreciably small. In the broad base of the H rail as much room exists for discrepancies in the width as in the height of the bar, and

where the lateral alignment of the rails is effected through the lower web, it is very liable to imperfection. The T rail is less subject to this difficulty than the H rail, and the Bridge rail (in consequence of the facility afforded by the hollow in its base, and into which the chair may be made to go up) still less than either; but the Z rail (it is considered) is the least liable to it of all. And in regard to the bending the bars to, and retaining them in, the line of curvature, the advantage of the Z rail over the H, and Bridge rail, is obvious; both from the more moderate lateral stiffness of the Z rail, and the more direct action and extended resisting surface and adjustibility of its fastenings. The wide bases of the H and ⊓ rails on which their strength and stability mainly depend, render them, it is well known, very difficult to deflect in curves, and next to impossible to prevent them from returning to the condition of *chords* from that of arcs, into which they had been temporarily forced in the construction of the track. The great increase of resistance and concussion in the passage of trains through curves situated in this way, need not be demonstrated.

7th.—The Z form of the section is the best adapted to bear the action of the wheels, the *coned* part of which, nearest the flange, imparting the most intense pressure, is received immediately by the *stem* of the rail, in which resides the main strength of every rail bar. In the T and H rails the stem is chiefly acted on through the inner ledge of the upper table, with a twisting action, unfavourable to the resistance of the bar; this part of the head suffering also much more severely from the wheel than the outer ledge. In the Bridge rail, the inner leg or half of the stem receives the principal action; the outer one being strained to a less extent—an inequality injurious to the strength and wear of the rail.

8th.—The simplicity of form of the Z rail section must make the rolling of it easier and cheaper than that of any other edge rail; while the disposition of the fibres and laminæ of the bar is as favourable as possible to strength and the endurance of wear.*

9th.—In efficiency, accessibility and capability of adjustment, the fastenings of the Z rail track possess, it is thought, strong points of superiority. The heavy strains and shocks to which railways are subject, and the consequent disposition of the numerous parts composing their structure, to give way and *work*, one with another, renders it very important that the attachments of those parts should be constantly open to inspection and very accessible. Fastenings capable of being readily tightened after working loose, such as key or screw bolts, are preferable therefore to spikes, or simple screws with-

* This opinion has been confirmed by that of a professional gentleman of great practical experience, in the manufacture of railway bars.

out nuts. But screw bolts used to fasten rails on the *top* of a timber support, must have either head or nut *under* the timber and buried in the ballasting, or filling of the track. In either case the bolt is much more difficult of inspection and adjustment, or removal, than the horizontal bolt of the Z rail.

10th.—The new proposed track is finally recommended by economy in the first cost and subsequent repairs, when contrasted with any known form of track of *equal strength of construction.*

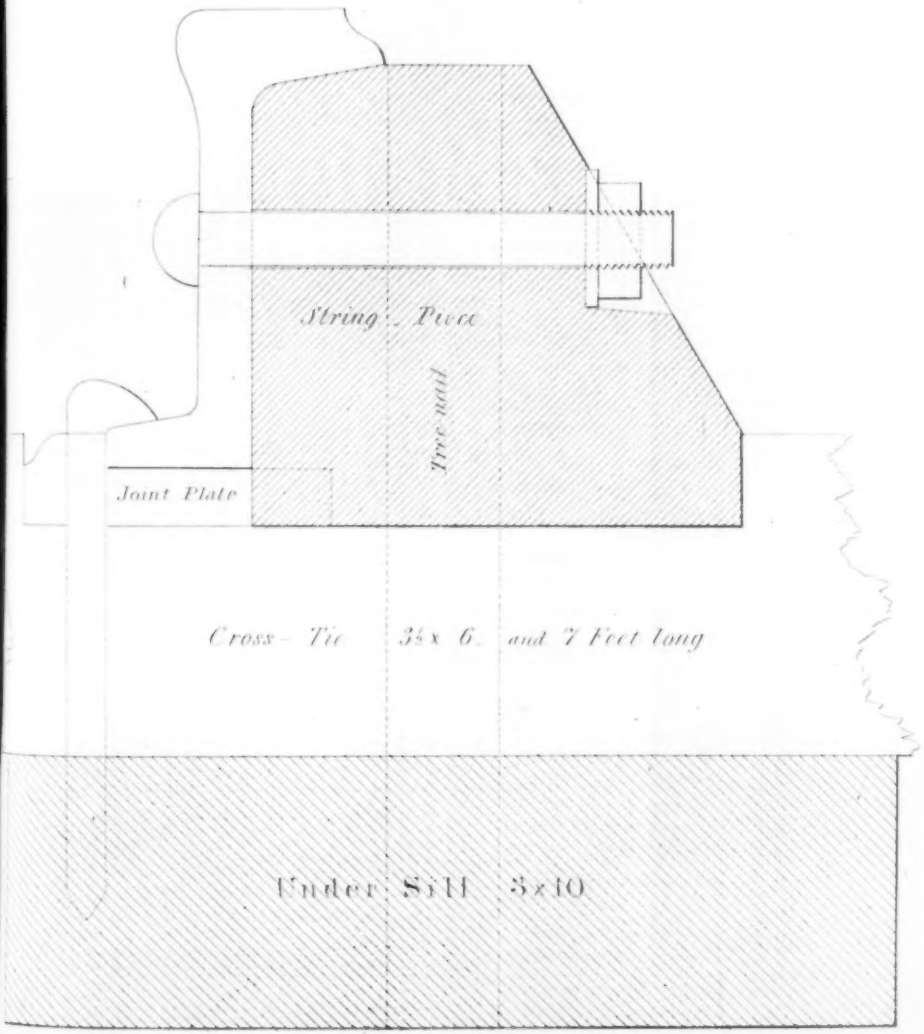
In the "comparative table" below, there are three tracks, viz: the Philadelphia and Reading, the Washington Branch, and the Baltimore and Port Deposit, which are nearly identical with the Z rail track of 45 lbs. per yard, in estimated cost—while three others, viz: the Camden and Amboy, the Newcastle and Frenchtown, and the Wilmington and Susquehanna, fall short of it from $350 to $750 per mile. The comparison of strength, stiffness and general stability between these tracks and the Z rail track (45 lbs. per yard) which is contained in the columns of that table, from the 8th to the 16th inclusive, will, however, justify the claim of greater economy of construction and repairs in behalf of the latter. And if we go to the Z rail track of 35 lbs. per yard, we see an actual saving of $567 per mile in first cost, over the cheapest of the others, and with *all things considered,* a stronger structure; for the strength of the *track,* as a combination of parts, does not depend solely on the strength of the rail, but largely on the stability of the *connexions* of all the parts, in which particulars (as shown in the 14th and 15th columns) the lighter Z rail is seen to be much better provided than the tracks with which it is here compared.

Z. RAIL

HALF SIZE DRAWING

of the Cross Section of

Rail, String-Piece, Cross Tie, Under-Sill &c



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TABLE, exhibiting the comparative weights, strength, stiffness, bearing surfaces, &c., of the Edge Rails used upon some of the principal Railways of the United States, with the relative quantities of timber, &c., employed in the superstructures connected with the several Rails, and the estimated cost of the Tracks per mile.

NAME OF RAIL ROAD, ON WHICH RAIL IS LAID.	Weight of rail per yd. linear.	No. of tons of rails pr. mile, pr. track	No. of lbs. of cast iron fastenings pr. mile.	No. of lbs. of wrought iron fastenings pr. mile.	No. of feet of timber, b'd measure, pr. mile in the track as constructed.	No. of ft. b'd measure pr. mile, with undersill 3 x 10 added to tracks without one.	Strength of the rail in tons, for a clear bearing of 30 inches.	Strength of the rail and string pieces combined, for same bearing.	Deflection of rail alone, under weight of 8 tons.	Deflection of rail under the weight by which its *strength* is expressed.	Deflect'n of rail & string piece comb'd, under weight of 8 tons.	Bearing surface, in square inches, resisting vertical pressure pr. running yard.	Surface resisting *lateral* pressure pr. lineal yard.	Surface resisting *longitudinal* pressure pr. yard.	Relative *virtual* bearing surfaces, having respect to relative *stiffness* of rails.	Estimated cost of a mile of single track on each plan, by the same scale of prices.
N. Jersey R. Road, T rail	38	59.71	52,800	2,728	63,360	——	4.21	——	.099	——	——	45.	4.7	.40	25	$10,700
Boston & Worcester, T do.	38½	60.5	52,800	5,280	50,483	——	4.21	——	.099	——	——	34½	6.4	.62	19	10,637
Balt. & Susq'anna, H. do.	58½	91.93	——	16,044	50,688	77,088	12.6	——	.050	.032	——	29.7	3.6	.56	51	11,556
Stoning'n & Provid'e, do.	58	91.14	7,040	4,752	82,720	——	12.6	——	.050	.032	——	22.5	3.75	.62	39	11,149
Long Island, do.	56½	89.	5,632	5,280	61,600	——	12.6	——	.050	.032	——	24.	3.	.62	41	10,587
Boston & Providence, do.	55	86.43	7,040	4,752	36,960	63,360	10.32	——	.054	.042	——	24.	3.	.62	31	10,352
Baltimore & O. R. R. do.	52	81.71	10,548	4,102	53,716	——	8.7	——	.055	.051	——	28.	4.	.62	31	10,354
Philad'a. & Reading, do.	45½	71.	5,910	5,005	55,174	81,574	8.11	——	.076	.075	——	26.9	4.	.62	20	9,451
Camden and Amboy, do.	45	70.71	6,600	2,237	60,555	——	7.65	——	.054	.056	——	19.	3.3	.62	19	9,114
N. Castle & F. Town, do.	43¾	68.35	1,056	2,259	62,480	——	7.65	——	.054	.056	——	18.	3.5	.62	18	8,736
Washington Branch, do.	40	62.86	9,856	2,112	95,040	——	4.97	18.47	.076	.122	.033	117.	5.	.80	51	9,519
Balt. & P. Deposit, sq. rail,	40	62.86	——	2,959	118,800	——	2.72	23.66	.118	.347	.045	90.	1.12	1.12	14	9,428
Wil. & Susq'a, bridge rail,	40	62.86	11,668	2,816	57,200	——	4.58	——	.077	.135	——	26 4/16	5.25	.50	11	8,752
Project'd bridge rail track	45	70.71	5,940	3,696	77,778	——	6.12	13.12	.069	.090	.044	130½	2.13	.65	80	9,927
Do. Z rail,	45	70.71	1,509	4,736	67,760	——	8.	10.41	.035	.035	.027	63⅜	9.12	1.60	100	9,482
Do. do.	35	55.02	1,509	3,269	67,760	——	5.72	9.85	.060	.084	.050	63	9.12	1.28	41	8,169

The stability of a railway track, like that of any other piece of framing or machinery, must be proportioned to the values of the resistances it presents to the several strains to which it is subjected. This being granted, as it must be, the undersigned feels himself warranted in appealing to the above tabular statement, as furnishing *demonstration* that the track which he has designed, is superior, in all the elements of stability, to any of its predecessors. In bearing surface to withstand *vertical* pressure, it is *twice* as well provided as the track which approaches nearest to it, and nine times better than the one which falls most short of it.

Its resistance to *lateral* movement, is 1½ times that of the track which comes the closest to it, and 8 times that of the one most behind it.

In the counteraction of *longitudinal* motion, it is better than the best of its competitors by nearly 50, and than the worst by 400 per cent.

Now, that improvement in these particulars in the present structures is wanted, the experience of every rail road company must have taught. The best and most expensively constructed railways of the country, cannot be closely inspected without its being perceived, that the connexions of their parts are too weak to withstand the action of their locomotive machinery. To a greater or less extent, in all those which have come under the examination of the undersigned, the wooden supports are crushed, the iron rails forced aside, and the joints either entirely closed or too widely opened. Spikes, bolts, and other fastenings, frequently give way, and where the maintenance of an accurate adjustment of the track is aimed at, much expense of material and labour, is incurred in replacing them; while the expedients resorted to, for restoring the deranged adjustments, cripple the timber, and convert the originally handsome structure into an unsightly piece of patch-work. There may be lines of railway, which have, in a measure, escaped these derangements; but has the trade and travel upon them been as yet very trying?

It may strike those who examine it, that the dependence of the Z rail, on the string piece, for *lateral* support and maintenance in its upright position, is objectionable. But when it is considered that on the string piece it is equally dependent for *vertical* support, like any other rail of continuous bearing on wood, the difficulty seems to disappear. The Z rail indeed *hangs* by its top on the inner edge of the string piece, just as the common plate rail rests thereon. The Z rail may, in fact, be regarded as an iron plating of the top and inside of the stringer; as long as the latter retains its stability, so long will the former—and we know that the stringer of the plate rail track would

stand very well, if it did not crush under the weights from which its thin bar so poorly protects it. But it will be said, that the Z rail does not bear on the string pieces alone, but also on the cross tie. True, and if the latter bearing acted, or sustained the whole weight independently of the former, the string piece would then perform the office of a simple side support. This it would, indeed, be entirely competent to; but in fact it must of necessity bear the vertical pressure of the rail also, in consequence of the *intended* insufficiency of the tie, to sustain it unaided. The bearing area upon the tie is but nine square inches per running yard of rail, a surface experimentally known to be too small to resist compression in the *hardest woods we have.** Should then, the bearing of the rail, through defective fitting of the parts in construction, be thrown at first on the tie, it will soon become compressed under the travel, so as to bring the top bearing of the rail on the stringer into action; and where the latter bearing is perfect in the first instance, but afterwards withdrawn by *shrinkage of the timber*, the rail gradually indenting the tie as the stringer recedes, will follow the latter and maintain the constant harmony of the two bearings. This expected result depends upon such simple and obvious principles of mechanical action, that the undersigned cannot feel hesitation in his confidence of its occurrence. The amount of shrinkage in the string piece, will not exceed about one-eighth of an inch in extreme cases, and this much, the tie will assuredly compress. The cast iron plate at the joints, extends the tie bearings there, but not more than the rail requires from its greater weakness at those points.

There are, then, the best reasons to believe, that the rail and string piece will act together as a single beam, whose proportional height and width and connexion with its supports, will give it all the stability of position that can be desired. The string piece being fitted close and confined in the notch of the tie by a treenail, it is proposed to compensate for the small shrinkage of the former, by driving a thin wedge between it and the outer shoulder of the notch, so as to keep the gauge of the track from widening. Any other form of rail resting on top of a string piece, would equally indeed require this adjustment. The impression, then, that the dependence of the Z rail on its string piece is, in reality, greater than that of any other section of bar, supported by a continuous bearing, will, it is believed, be removed by reflection from the minds of those who may naturally receive it from a slight examination of the subject, and their ultimate conclusion, it is thought, will be, that the Z rail holds, on the other hand,

* The *locust* ties upon the new track of the Baltimore and Ohio Rail Road, when the bearing area is 28 inches per running yard, have all become more or less indented by the base of the rail.

the best possible position with respect to the timber with which it is connected, and that it will suffer no more from the decay of the wood than will any other rail, upheld in any other manner by a similar material.

BENJAMIN H. LATROBE, *Civil Engineer.*

Sketch of the Vicksburg and Jackson Rail Road, in Mississippi.

The Vicksburg and Jackson rail road extends from Vicksburg, on the Mississippi river, to Jackson, the capital of the State, on Pearl river, being, on the whole, a distance of 45 miles. It was commenced under the engineering supervision of H. S. Van Rensselaer, finished under that of Jeremiah Van Rensselaer, and opened to the public on the 1st of October, 1840.

Nature of the country.—Vicksburg, the western terminus, is situated on the side of that well known range of hills which make their appearance at Fulton, Randolph, and Memphis (the Chickasaw bluffs) in Tennessee, and at Vicksburg, Grand Gulf, Natchez, and Rodney, in Mississippi; they present, however, much less formidable impediments to internal improvement, in the former state, than in the latter, assuming, here, the appearance of small broken knobs, rarely uniting in ridges of any extent, and frequently intersected by ravines containing small streams of water, which, owing to the absence of materials for substantial culverts, have, on this road, rendered frequent recourse to trestle work, necessary. It may be proper here to state that, beside the termini, there are three principal depots, viz. Bolton's, Edward's, and Clinton, at the respective distances of 26, 18, and 34 miles from Vicksburg.

Soil.—The earth in the hills which extend from the Mississippi river to the Big Black, is of a yellow clay colour; it works easily with the pick, stands well, in excavation, at a slope of ½ to 1, and when trimmed with the shovel, will turn the rain, with scarcely any wash; when used on embankment, however, it becomes necessary to sow it with grass. From Big Black to Clinton, the ground is generally flat, and often marshy; the earth in the low ground being of an ashy colour, and making an excellent embankment; as you approach Clinton, the soil takes a sticky nature, melting in every rain, and hardening in the sun, so as to be almost intangible to the pick; in the excavations, great quantities of crystalized gypsum, and sometimes stone, are found, the latter is very soft and deliquesces when exposed to the air; the first mentioned properties of this earth render it very troublesome in *cuts*, it will hardly stand at a slope of 1½ to 1, and, in several places, piles have been driven (in one place, for half a mile,) to prevent its en-

croaches on the track; this kind of soil is found in all the excavations between Clinton and Jackson, which latter place is situated on the low ground of Pearl river, and but little above high water.

The following statement shows the relation between the straight lines and curves from Vicksburg to the depot, one mile from the eastern termination of the road, in the town of Jackson.

	Length in miles, and chains.							
Straight line	"	31	"	76,				
Curves,	"		"	78,	having a radius of		7560	feet.
"	"	4	"	36,	"	"	3780	"
"	"	1	"	46,	"	"	2520	"
"	"	3	"	34,	"	"	1890	"
"	"		"	54,	"	"	1512	"
"	"		"	32,	"	"	1260	"
"	"		"	34,	"	"	1080	"
Total,		43	"	70.				

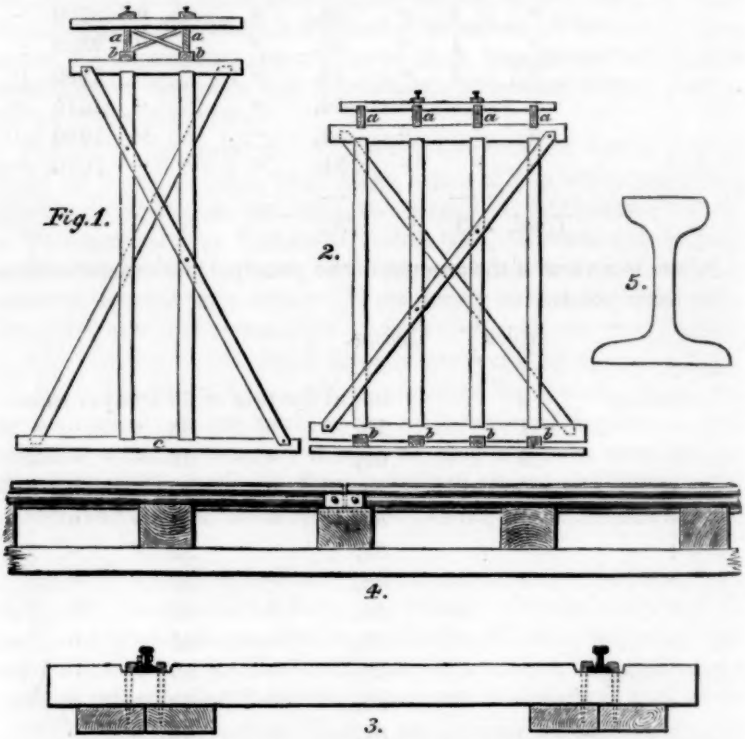
Below, is a view of the amount of the principal grades intermediate to the same points.

	Miles.	Chains.				
Level.	7	22.				
Ascending.	2	26,	at the rate of	55	feet	per mile.
"	1	18,	"	53	"	"
"	2	04,	"	48	"	"
"	5	24,	"	40	"	"
"		57,	"	36	"	"
"		35,	"	35	"	"
"	1	28,	"	32	"	"
"		40,	"	28	"	"
"		40,	"	25	"	"
Descending.		48,	"	50	"	"
"		33,	"	48	"	"
"	3	54,	"	42	"	"
"	3	29,	"	40	"	"
"		22,	"	36	"	"
"		53,	"	34	"	"
"		40,	"	33	"	"
"		67,	"	32	"	"
"	1	32,	"	28	"	"
"		17,	"	24	"	"
"		47,	"	20	"	"

Grading.—The excavations are made 18 feet wide at the bottom,

and sloped at the rate of six inches to the foot, embankments 14 feet wide at top, with a slope of 1½ to 1.

Bridges.—There are seven sets of trestle work upon the road, of which that on the eastern bank of the Big Black river is the most extensive, it reaches half a mile, in spans of 22 ft., being, at its greatest elevation, 52 ft. in height; a section of it is shown in Fig. 1, *a* represents the corbel, or splice cap; *b*, the stringer, 22 feet long; the sill, *c*, is supported by piles, three under the foot of each post, and two under that of each brace.



Trestle work, No. 1, 3 miles from Vicksburg, is 165 feet long, and has an average height of 47.

Nos. 2, 3, and 4; 4, 9, and 11 miles from Vicksburg, are, respectively, 216, 410, and 478 feet in length. The King-post bridge, situated within a few yards of T. W., No. 2, extends 561 feet, in 17 consecutive spans of 33 feet each, supported by trestles, similar to those used at Big Black.

The bridge at the second crossing of Baker's Creek, 26 miles from Vicksburg, is a species of trestle work 100 feet long, in four 25 ft. spans.

The trestles are supported by piles driven into the bed of the creek; a section of it is represented in Fig. 2; *a*, the stringer, *b*, *b*, *b*, *b*, sills, acting as ties to the trestle, at the surface of the water.

The Big Black river is crossed at an elevation of 70 feet, by a bridge on Col. Long's plan, 416 feet long, the main span being 150 feet; this bridge is 17½ feet wide, has a treble set of posts, and quadruple set of stringers on each side, the posts are 20 feet long, and longitudinally of the bridge, 10 feet apart; immediately on leaving the bridge, you arrive at the trestle work, before mentioned.

At the first crossing of Baker's Creek, is a similar bridge, in one span of 80 feet.

Superstructure.—A side and end view of the superstructure are represented in Figs. 3 and 4. It consists of foundation sills, cross-ties, and iron, the sills, 3½ × 10, are laid two and two on each side of the track, to break joints, the cross-ties, 5 × 7, are 7 feet long, and 2 feet apart from centre to centre. The sills and ties, for about half the length of the road, are cedar, the rest, cypress. The iron, a pattern of which is represented in Fig. 5, weighs 43 lbs. per yard, and is laid down in bars 18 feet in length, in such a way as to break joints; the spikes used, weigh three-fourths of a lb. each, and the plates under the ends of the rails, 2⅛ lbs. each; 20 of the former are used to each bar.

There are 66 cars, (counting 4 wheels as a car,) at present used for transportation; they are, principally, 8 wheeled, and cost $800 each; 7 engines, 4 of which are of Baldwin's make, are in the possession of the company. The 5 employed during the last 3 months, have, in that time, travelled 26,014 miles, and cost, for repairs, $756, which includes the breakage of a crank.

The expenses for motive power, during the months of October, November, and December, including pay of engineer and fireman, fuel, oil, and repairs of engines, &c., amounted to - $4,350 50

The maintenance of cars, for the same period,	758 50
The maintenance of way, - - -	9,278 34
Total expenses for the months of October, November, and December, were, - -	30,348 20
" receipts, - - - - -	55,015 35
Excess of receipts,	$24,667 15

I have taken the liberty to lay this communication before your readers, from the consideration that a brief account of the result of an enterprize upon which 2¼ millions of dollars, in northern capital, have been expended, might be productive of interest to them, and hope

that those possessing information relative to the more important ones at the North, will lay it before the public. G. C. W.

Extracts from the Second Report of the Directors of the New York and Erie Rail Road Company, to the Stockholders, February 3rd, 1841. Signed, by order of the Board of Directors, by* ELEAZAR LORD, ESQ., *President of the Company.*

Of the Route, Surveys, and Relations of the Road.

The route is in all respects most eligible for a work of such extent. Proceeding westwardly, from the harbour of New York, it traverses eleven counties within this State, its course being nearly midway between, and eighty to one hundred and twenty miles distant, from the Erie canal, and the canals which extend westward from Philadelphia. The physical character of the country precludes the construction of any rival work within fifty miles or more on either side; while the numerous streams and valleys which are intersected, afford great advantages of access to adjacent districts on the right and left.

The road will therefore, naturally, command the travel and tonnage of a very wide and extended region, comprising twenty-five or thirty thousand square miles, and a numerous population, besides a large proportion of the travel and traffic of the lakes and western states.

The line, moreover, has the advantage, on more than three quarters of the whole distance, of being laid in the valleys of rivers, and other considerable streams, as the Ramapo, the Delaware, the Susquehanna, the Chemung, the Canisteo, the Genessee, and the Alleghany rivers, and their tributaries, where the grades are extremely favourable, and the soil in the valleys west of the Delaware, adapted to the use of piles.

Excepting the portions previously located, surveys of the entire line of the road have been performed within the past year, including careful, and in some instances, very laborious examinations of different routes. It was the object of these surveys to improve the line as far as possible in respect to its length, grades, curvature, adaptation to the use of piles, economy of construction, and susceptibility of farther amendment with reference to an additional track; the directors having had it specially in view to establish the location where it ought to be, on the supposition of the road hereafter attaining all the importance as a thoroughfare of trade and travel, which the most sanguine have anticipated for it, and at the same time to secure the construction of a single track with the utmost practicable economy.

The original survey by Judge Wright, which possessed extraordinary merit, and entitled him to the enduring gratitude and respect of the company, exhibited a line four hundred and eighty-three miles in length; but at the same time indicated the most important points where farther examinations would probably result in shortening the distance, and in securing other advantages. Between his survey in 1834, and the close of 1838, re-surveys of the whole line and of dif-

* Extracted from the Report and Appendix. Communicated by Major T. S. Brown, C. E.

ferent routes on portions of it, costing, in the aggregate, more than $100,000, resulted in little more than a confirmation of the recommendations and suggestions contained in his report to the Legislature.

The surveys and examinations of the last year leave no room to doubt but that the line selected from Piermont to Deposit, one hundred and fifty-seven miles, and from Binghamton to Dunkirk, two hundred and fifty-one miles, is, taking every important consideration, present and prospective, into view, the best that can be obtained. Its length, allowing thirty-eight miles for the distance from Deposit to Binghamton, is four hundred and forty-six miles. It admits of a convenient and advantageous distribution into divisions, to be worked respectively by locomotives adapted in weight to the ruling grades of the several portions.

Next in importance to the route and location of the road, are its relations to other avenues and sources of travel and business.

Under this head it is obvious, first to notice its relation to the city of New York, the great mart for the products of this and the western states, and of the merchandize to be transported in return, for consumption in the interior; where, from the east and south, the great lines of travel meet, and where emigrants, and other passengers from Europe, for the most part make their landing in the country. When it is considered that the road extends, by the shortest practicable line, from this city to Lake Erie; that it is designed for the transport of heavy tonnage, as well as of passengers; that it will be open for use throughout the year; that the plan of its construction will render it competent to any conceivable amount of business, and that passengers may with safety be transported over it from one extremity to the other, in eighteen or twenty hours; the importance of its connexion with this metropolis, and the value of its local effects here in obviating the disadvantages of a northern climate, and rendering business as active, and supplies as cheap, in the winter as in the summer months, cannot fail to be apparent.

It has been supposed by some, that the termination of the road on the western shore of the Hudson, about twenty miles from this city, would prove disadvantageous, at least for some five or six weeks of the winter season; and in anticipation of such an objection, provision was made in the charter for extending the line to the city, from a point opposite to the Company's pier. Below that point, however, there is seldom, even temporarily, more obstruction from ice than on the ferries opposite to the city. The present winter, owing to the quantity of ice and the occurrence of severe storms, has occasioned difficulties as formidable as are likely to occur hereafter. Nevertheless, the company's boat has regularly performed her daily trips, and by her punctuality and success, has removed all doubt, and established full confidence, of the safety and advantage of this mode of communication with the road.

The pier, which extends about 4000 feet into the Hudson, forms a safe and valuable harbour, in connection with abundant space for all the accommodations of a depot.

Proceeding westwardly, the road passes through the valley of the

Ramapo, and a region of the most valuable iron ores, and divides the county of Orange into nearly equal parts. From Goshen, situate near the centre of the county, railways are proposed to Newburgh, distant about twenty miles; to the line of New Jersey, in a south-westerly direction; and to the north, through Kingston, Saugerties, and Catskill to Albany; of which the two former have been chartered. Near the western boundary of Orange, the line approaches the Delaware river, and intersects the Hudson and Delaware canal, which extends from the Hudson river, near Kingston, to the Anthracite coal beds of Pennsylvania.

In the county of Delaware, a rail road is proposed from Delhi, or from Walton, to Deposit.

In Broome county, the road intersects the Chenango canal, which extends from the Erie canal at Utica to the Susquehanna river; and also the line of a proposed railway from Utica to the Susquehanna, which has been chartered and surveyed; and another from Binghamton through Cortland and Onondaga counties, to Syracuse, and thence to Lake Ontario at Oswego, which has been chartered, and which, in connection with this road, will offer the most direct and eligible route from this city to Upper Canada.

At Oswego, in the county of Tioga, a connection occurs with the Ithaca and Oswego rail road, which extends from the Susquehanna to Cayuga lake, by the navigation of which, it forms an important route from the Erie canal. Near Tioga point, a connection is anticipated with the North Branch canal in Pennsylvania.

In the county of Chemung, the road intersects the Chemung canal at Elmira. The same point is contemplated as the termination of a rail road, which is in part constructed, from Williamsport in Pennsylvania, a distance of about seventy-five miles. To perfect a continuous line of railways from Philadelphia to Elmira, and thence, by a road of this Company, to lake Erie, is a principal object of this road.

It is supposed by some, (who, of course, are not aware how much the grades have been reduced, and the line shortened, on the eastern half of this road, since the original survey,) that on the completion of such a continuous line from Philadelphia to Elmira, the distance and amount of rise and fall between these two points will be less than between Elmira and the eastern termination of this road; and that both trade and travel will therefore be diverted from this route to Philadelphia. An examination of the subject has removed all apprehension of danger from this source. The distance from Elmira to the Hudson at Piermont, supposing the most eligible line from Binghamton to Deposit to be adopted, is two hundred and fifty-two miles, and the aggregate of ascents and descents, 3820 feet. The interval between Piermont and this city is entitled to be regarded only as a ferry.

From Williamsport to Philadelphia, several routes are projected and partly constructed; of which the most direct is that by way of Sunbury, Pottsville and Reading. Of this line, one hundred and fifty-one miles are nearly finished. Its length from Philadelphia to Elmira is two hundred and fifty-eight miles, and its rise and fall 5050 feet. It is moreover, encumbered with nine formidable inclined

planes, on which stationary power will be required, and is therefore not eligible for general trade or passengers. The next route in point of distance, is that via the Muncy Hills, Catawissa, and Reading, of which the length is two hundred and sixty-five miles, and the rise and fall 5530 feet; of this one hundred and fifty-two miles are completed, or far advanced. The third is a modification of the last mentioned route, and passes from Williamsport to Catawissa, by the valleys of the West and North Branch, instead of crossing the Muncy Hills. It is longer than those above referred to, but has less elevation to encounter, its length being two hundred and eighty-three miles, and its rise and fall 4630 feet; one hundred and fifty-two miles are nearly finished. The only remaining route passes down the Susquehanna to Harrisburg, and thence by way of Lancaster to Philadelphia, of which the length is two hundred and seventy-eight miles, the rise and fall 4790 feet, and the portion finished, one hundred and twenty-six miles.

Each of these different routes is in the hands of four or five distinct companies, and of course subject to the disadvantages incidental to separate interests and diverse modes of superstructure and management. The first is placed out of the pale of comparison by its inclined planes. The second is thirteen miles longer, has 1710 feet more of rise and fall, and cannot, from the arrangements of its grades and curves, be worked so economically. The third is longer by thirty-one miles, and has 810 feet more of rise and fall. The fourth has an excess in length of twenty-six miles, and in rise and fall of 970 feet.

Our road therefore, in view of this brief statement, to say nothing of its uniform character and management, or of the preference due to New York as a market, can be considered in no hazard of a diversion of its business by the lines in question, while as routes both of travel and transport from Philadelphia to lake Erie, and for the conveyance of coal and of iron from the district north of Williamsport, the Pennsylvania works will be largely tributary to the productiveness of the road of this Company.

At Corning, in the county of Steuben, the railway, forty miles in length, from Blossburg, in Pennsylvania, occupied chiefly in the transport of bituminous coal, terminates in the line of this road; which also, at the same place, intersects a navigable feeder of the Chemung canal. From Painted Post or Erwin, near the junction of the Canisteo with the Conhocton river, a rail road is proposed to be connected with this, extending up the valley of the Conhocton to the village of Bath, and thence to the Crooked lake.

In the county of Alleghany, at Cuba, the line of the road crosses the Genessee Valley canal, which extends from the Erie canal at Rochester, to the Alleghany river, a distance of one hundred and seven miles.

The line passing down the Olean creek, in the county of Cattaraugus, approaches the Alleghany river, along the northerly side of which it extends about thirty miles.

From the termination at Dunkirk, on the shore of lake Erie, a rail

road has been chartered and surveyed to Buffalo, forty-two miles; and another is proposed in the opposite direction, to be extended along the Southern shore of the lake, into the state of Ohio; from the Eastern border of which state, a continuous line of rail roads has been chartered, and portions of it constructed, through Ohio, Indiana, Michigan and Illinois, to the Mississippi, opposite to St. Louis, to be intersected in Illinois, by a route from the city of Cairo, at the junction of the Ohio and Mississippi.

The harbor of Dunkirk is spacious and secure. It is open earlier, and occasionally some weeks earlier, in the spring and later in the autumn than that of Buffalo.

This brief notice of the relations of this work to those natural and artificial avenues which intersect its route, and are already open, or are confidently anticipated, may serve in some degree to indicate its probable command of business, and its high claims to the confidence of its proprietors and of the public.

An examination of a map of this and the adjoining states, will show that most of the routes of travel and transport above noticed, are intersected nearly at right angles, which sufficiently characterizes them as tributaries instead of rivals. Their aggregate length is far greater than that of the main avenue. Those extending to the right will supply for distribution in the Southern, the salt, lime, gypsum, and various manufactures and products of the Northern counties of this State; while those approaching from the South and West, will furnish for transport from numerous points, anthracite and bituminous coal, iron, and the products of agriculture and of the forest.

Of the Cost of the Work.

The former estimates, as revised in 1835 and 1836, of the cost of constructing the work with a light superstructure and common plate rail, amounted to $6,000,000. In these estimates, however, land-damages, depot buildings, water stations, and some other items, were omitted. Were the road, after being prepared under the contracts which have been made for grading and piling, to be finished with a superstructure like that formerly proposed, the cost would not exceed the amount above represented.

In the estimates above referred to, the cost of grading and preparing the road for the superstructure, amounted to $ 3,900,075. Under the contracts which have been made, and to the extent of about one-third executed, and which cover the entire line, except the section between Binghamton and Deposit, about thirty-eight or forty miles, with an estimate supposed to be liberal for that section, the cost of grading, piling, bridging, masonry, &c., to prepare the road for the superstructure, will amount to $3,840,000. The character of the work, however, which has been, and is to be, executed under these contracts, is deemed to be in some respects much superior to that contemplated in the original estimates, so as to adapt it with an edge rail, to the use of locomotives of double the weight formerly intended, and to the conveyance of proportionately heavier loads. The masonry is accordingly more solid and permanent; the bridges are

stronger, and in some instances, the grades are improved, and the line shortened, at considerable additional expense.

The adoption of piles in the construction of nearly two hundred miles of the road-way, is likewise deemed a great advantage over the ordinary method of grading. The piles used are generally of white oak, about twelve inches in diameter. They are driven by steam power, five feet apart from centre to centre, to such depth in all cases as to secure them from the effects of frost, and with such force as to leave them in no danger of settling under the pressure of any load. The tops of the piles being protected by timbers wide enough to cover them, it is supposed that they may endure about twelve or fifteen years. They form a road of uniformly even surface throughout the year, which is not liable to be obstructed by snow, and while they continue sound, will be subject to little or no expense for repairs. The difference between a piled and graded road for annual repairs will, it is believed, be sufficient in five or six years to defray the entire cost of renewing the piles; while the expense of working such a road, owing to the constant evenness and good condition of the rails, will be very considerably less than is commonly incurred on graded roads.

But though the preparation of the road-bed is not expected to cost more than was formerly contemplated, a very important change has been made in the plan and character of the superstructure, which will materially enhance its expense. The Directors being, after due investigation, satisfied that the ordinary plate rail and light timber formerly proposed, would be inadequate to the objects and business of this road, and in every point of view inexpedient, adopted an edge rail, of the most approved form, weighing fifty-six pounds per lineal yard, which, with the requisite chairs and spikes, will cost, delivered and distributed on the road, about $ 6,800 per mile of single track. This rail, instead of being supported only on cross ties, laid at intervals of three to five feet, as is the case on other roads, is to be laid on heavy longitudinal sills, connected by cross ties framed upon the upper surface, these sills, by giving to the iron a continuous bearing, contribute greatly to the strength and safety of the track.

The cost of this superstructure, including all materials excepting iron, with the labor of framing and laying it down, and laying the rails, will be about $ 1,900 per mile, making the entire cost of the rails, chairs, spikes, timbers and workmanship, $ 8,700 per mile.

Supposing the length of single track required in the first instance, with the necessary side tracks and turn outs, to be five hundred miles, the cost of iron alone, will, on the plan adopted, be $ 3,400,000; and of timber, workmanship, etc., $ 950,000, making $ 4,350,000, which is 74 per cent. more than was formerly allowed for the entire cost of the superstructure.

For the satisfaction of those who are not aware of the considerations which justify so enlarged an expenditure, it may be useful to refer to the experience of others on this subject.

The heaviest wrought iron rails in use in England, prior to the construction of the Liverpool and Manchester railway, were those on

the Stockton and Darlington road, which weighed but twenty-eight pounds to the yard; and proved to be much too light for general traffic, and unsafe for rapid travel. Rails, therefore, weighing thirty-five pounds to the yard, were adopted; but these also proving insufficient, were removed and others of sixty-four pounds were substituted, which still remain in use.

Profiting by the experience of the last mentioned Company, the Directors of the Liverpool and Manchester road adopted in the first instance a rail of thirty-five pounds, then the heaviest which had been used in England. A single year proved its insufficiency, and it was speedily followed by one of forty-four pounds, which again gave place to a different pattern, weighing fifty pounds per yard. A very few of the latter remain at present on the road, those now in use being chiefly of four different patterns, weighing respectively sixty, sixty-two, seventy, and seventy-five pounds per yard. Experience thus induced improvements in the construction, and an increase in the weight and cost of rails, until the vast strength of the forms of section now most approved, was attained.

The rails laid on the Midland Counties road, weighed per yard, - - - - - - - 78 lbs.
Those laid on the Eastern Counties road, - - 76 lbs.
Those on the London and Birmingham, the London and Southampton, and London and Brighton Roads, - - - 75 lbs.
Those on the North Eastern Counties road, - - 69 lbs.
Those on the North Midland, and the Manchester and Birmingham roads, - - - - - - - 65 lbs.
Those on the Great North of England road, - - - 62 lbs.
Those on the Great Western, now in progress, - - 56 lbs.

Of these, one only is as light as that adopted for this road; and in that instance, as in ours, the rail has a continuous bearing on a longitudinal sill; while all the others are supported on chairs, at intervals of three to five feet, weighing from twenty to over thirty lbs. each.

In this country, likewise, the results of experience abundantly show, that wherever it is an object to construct a railway, it is to the last degree desirable to obtain a heavy rail. On several roads where a light bar was originally laid, it has been replaced by one better adapted safely to permit rapid traveling, to sustain the severe shocks incident to a heavy trade, and to admit a constant and economical use; of such, the Columbia, New Castle and Frenchtown, Baltimore and Ohio, and others, might be referred to as instances.

The following statement of the cost of superstructure with heavy rails, on several roads, is extracted from a pamphlet published by B. H. Latrobe. The author does not give the actual cost in the several instances, but the calculated cost of the different plans of superstructure, at a tariff of prices, which he deems a fair average of this country:

Baltimore and Susquehanna, - - - $11,556 per mile.
Stonington and Providence, - - - 11,149 "
New Jersey, - - - - - 10,700 "
Boston and Worcester, - - - 10,637 "

Long Island,	$10,587 per mile.
Baltimore and Ohio,	10,354 "
Boston and Providence,	10,352 "
Washington Branch,	9,519 "
Philadelphia and Reading,	9,451 "
Baltimore and Deposit,	9,428 "
Camden and Amboy,	9,114 "
Wilmington and Susquehanna,	8,752 "
Newcastle and Frenchtown,	8,736 "
Average of the above,	$10,026 "
New York and Erie,	8,700 "

It was believed that with a plate rail, the road would be wholly inadequate to the travel and transport which it ought, and, if properly constructed, assuredly would command; that it would be unsafe for passengers, would be subject to enormous expense for repairs, and could not be economically used for the conveyance of tonnage; whereas, with a heavy rail, it would be competent to all its objects, could be worked with economy, would require but a moderate expense for repairs, and would be so much more productive and valuable, as to justify the confidence necessary to render it easier to accomplish its construction on the plan of an enlarged expenditure, than to carry out that originally proposed.

The cost of land and damages will be unusually small, probably not exceeding an average of $ 500 per mile; about three-fourths of the whole line, and suitable sites for depots being released without charge, and further gratuitous cessions being anticipated. Other donations of land having been made of the value, probably, of $ 1,000,000, and certainly more than sufficient to cover the cost of land for the roadway, this item is not brought into view in the following estimate of the cost of the work, viz:

For preparing the roadway for the superstructure, which includes grading, piling, masonry, bridging, fencing and superintendence,	$3,840,000
For iron rails and appendages delivered and distributed,	3,400,000
For timber and workmanship for superstructure,	950,000
For locomotives and cars sufficient for the first operations on the road,	400,000
For passenger and freight depots, machine shops, water stations, engine houses and other necessary buildings,	200,000
For interest and contingencies,	210,000
	$9,000,000

In view of this estimate, which is so far founded on actual contracts, experience, and ascertained facts, as to be deemed worthy of confidence, it is apparent that further resources of capital than are yet at the disposal of the company, will be required. The Directors rely on the stock of the company, after large allowance for the disastrous consequences, to many of the original subscribers, of the conflagration in this city in December, 1835, and the commercial revulsion of the

ensuing years, for at least $3,000,000. The loan of the State heretofore granted, is of the like amount; and they trust that the progress, condition and promise of the undertaking, will be such, before the close of the present year, as to leave no doubt of the expediency, safety, and public utility, of such further aid from the State, as the speedy completion of the work shall require.

The contracts for grading and preparing the roadway, including the superstructure of wood, on about two hundred and forty miles, require the execution of those parts of the work within two years; the payments for which will be discharged by collections on the stock of the company, and the proceeds of State stock yet to be received under the existing law. The farther needful resources will be required for the purchase of iron. On the plan of preparing the roadway within two years, or thereabouts, it is highly desirable that the Company should be enabled to contract for the iron rails, of which 35,000 tons are yet wanted, and for locomotives and cars, in the course of the present year, on account of the length of time required for their manufacture, and delivery on the line of the road. The importance of the entire line being put in use, and rendered productive within the shortest possible period, after the road-bed is prepared, is apparent.

[TO BE CONTINUED.]

Architecture.

The Orders.

It is often asked by those who have never given much attention to the subject of architecture, why *new* orders are not invented, and architects are reproached for adhering to the proportions derived from the ancients. It will not, however, be difficult to show that such censures are unjust, as well as unreasonable.

The orders must either depend for their character on *proportion* or on *embellishment*. If their *proportions* are to be considered as constituting their distinctive qualities, we shall find the number inevitably reduced to three, without the possibility of ever increasing it; but if their *embellishments* are to be regarded as marks of distinction, we shall find *thousands* of orders, both ancient and modern; and almost every architect may claim the credit of having added to the stock.

The *proportions* of the orders are naturally resolved into the *robust*, the *chaste*, and the *elegant*; in the Doric, we have the most massy effect that can be given to a column and entablature, consistent with the principles of beauty; in the Corinthian, we have all the lightness and delicacy that can be attained, without imparting an idea of weakness; while a medium between the two is found in the Ionic. In the Doric, therefore, we have *strength, robustness*, and *masculine* vigour; in the Corinthian, elegance, lightness, and feminine delicacy; and in the Ionic, a beautiful blending of these extremes into chasteness and

dignity. We may therefore attempt, with as much propriety, to add another letter to the alphabet, or another note to the musical scale, as to add to the number of these natural grades of proportion, called orders. Hence, instead of censuring modern architects for not inventing *new* orders, we must abuse the ancients for "using up" all the principles for proportioning them to be found in nature.

But if on the other hand, an order is to be recognised by its *embellishments*, then almost every building of antiquity may be said to be of a different order, as there are scarcely two to be found, in which the decorations of the columns and entablatures are precisely similar; if, for example, we refer to the monument of Lysicrates, and the tower of Andronicus Chyrrhestes, we shall find two antique specimens of the Corinthian order, presenting, in their embellishments, the extremes of poverty and richness, yet no one has ever thought of calling them separate orders. Many examples exist in our own country of columns and entablatures, which differ widely in their decorations from any thing the ancients ever did—Mr. Latrobe, for example, made an order in the entrance to the Supreme Court Room in the capitol at Washington, which is often denominated the *American order;* and if any modification of either of the three grand divisions of columnar architecture is entitled to the distinctive appellation of an order, that undoubtedly is; the shaft of the column is ornamented with the representation of twenty-four stalks of Indian corn, instead of the ordinary flutes and fillets; and the capital has the form of an inverted bell surrounded with eight ears of corn, a portion of the grains of each ear being gracefully displayed between the opening husks; the astragal between the shaft and the capital is made to represent a rope. But this order, novel and ingenious as it is, can only be considered as a modification of the Corinthian, having the same proportions, a bell-shaped capital, and foliated embellishments.

The same may be said of the two orders called Tuscan and Composite, which are usually added in Roman architecture to the three derived from Greece. The Tuscan is a mere coarse adaptation of the Doric, and the Composite, a blending of the Ionic and Corinthian in the proportions of the latter. Vitruvius, who wrote on architecture in the time of Augustus, speaks of these modifications, but nowhere calls them orders. There is, in fact, but *three* orders, the *Doric*, the *Ionic*, and the *Corinthian;* the *Tuscan* and the *Composite* not having the slightest claim to such an appellation.

In this view of the subject, we can never expect the invention of an entirely new order, nor is such an event desirable, even though it were practicable. Columnar architecture having reached *perfection* in the hands of the ancients, any attempt to improve the orders, or

to add to their number, would be nothing short of an attempt to improve perfection.

> "To guard a title that was rich before,
> To gild refined gold, to paint the lily,
> To throw a perfume on the violet,
> To smooth the ice, or add another hue
> Unto the rainbow, or with taper light
> To seek the beauteous eye of heaven to garnish,
> Is wasteful and ridiculous excess."

These observations are, of course, intended to apply exclusively to the art of building with columns. The architect may produce the most elegant compositions without having any reference whatever to the orders; but whenever he finds it necessary to introduce an entablature with insulated supports, he must turn to the principles developed by the ancients. T. U. W.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN JANUARY, 1840.

With Remarks and Exemplifications by the Editor.

1. For a *Horse Power;* Samuel S. Allen, Miamisburg, Montgomery County, Ohio, January 10.

In this horse power a vertical shaft is to be turned by means of a sweep, or lever, to which the horse is attached. This lever carries a wheel with teeth on the interior of its rim, which mash into two pinions, or wheels, and these into a pinion on the vertical shaft, an arrangement which is well known. The patentee observes that "it is a point of primary importance that there should be a perfectly equal bearing on the teeth, or leaves, of the pinions, an object which cannot be obtained by mere truth of workmanship." This equal bearing is obtained by allowing a small degree of lateral play to the upper gudgeon of the shaft, to compensate for want of truth, and unequal wear, in the pinions.

The claim is to "the manner of causing the teeth, or leaves, of the pinions to have, at all times, an equal bearing, by allowing play in one direction to the upper gudgeon of the main shaft, within its box, or bearing, as described." This is one of those small things which might suggest itself to any one, but which from its very simplicity is apt to be overlooked; when proposed, however, its utility is perfectly apparent, and is more worthy of a patent than many things requiring much more thought to mature them, but which, when matured, are of little practical utility.

2. For *Disengaging Horses from Carriages;* Edwin Eastlack, Greenwich, Cumberland County, New Jersey, January 10.

The inventions for disengaging horses, when running away with a carriage, have been numerous, and several patents have been obtained for such inventions both here and in England, not one of which has been continued in use; their abandonment has not resulted from any inherent defectiveness in the means, there not having been any difficulty on this point, although they have, of course, differed in merit. There is a general indisposition to the use of such devices, as if they invited accident, and there is also some doubt whether, in a very large number of cases, it is not more safe to leave the horses attached to, than to disengage them from the carriage.

The arrangements made by the present patentee appear to be well devised, and they are elaborately described; the particular means adopted form the subject matter of the claims.

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3. For improved *Hurdles for Feeding Silk Worms;* Benjamin Benson, Smyrna, Kent County, Delaware, January 10.

"To my hurdle frame I append an endless revolving apron for the purpose of readily removing the filth from the worms; which endless apron I conduct in a manner which renders it much more convenient than the apron employed in the machine of Gamaliel Gay, upon which this is an improvement." "In the apparatus for which letters patent were obtained by Gamaliel Gay, a separate cloth or apron was appropriated to each hurdle, and the rollers upon which it was wound were placed on the sides of the frame, rendering it necessary to employ a much larger space between the respective frames than upon my plan, and greatly increasing its complexity, and the labour of using it." Mr. Benson passes an endless apron under a series of hurdles arranged in a line, and placed one above the other, and this apron is conducted by rollers which cross the hurdle frames, and are turned by means of a winch at one end of it.

Another improvement consists in the particular manner of constructing the hurdles, by which strips of paper are allowed to descend in a fringe-like manner from their lower sides, serving for the worms to mount upon, and also as a convenient lodgment for their cocoons.

The claims made are to "the mode of arranging an endless revolving apron passing lengthwise of a general frame containing several tiers of hurdles for feeding silk worms; it being constructed in such manner as that one apron shall serve to collect and convey the filth from all the hurdles, in the way set forth, likewise the particular manner described of constructing the frames for a lodgment of cocoons, said frames consisting of sides pieces, slats, or covering of cloth, and strips of paper, or other material, combined or united together substantially as set forth.

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4. For a *Steam Cooking Stove;* Peter Getz, City of Lancaster, Pennsylvania, January 11.

This stove is not well represented in the drawing, or clearly described in the specification. Its main feature is the placing of a boiler at its back end, which shall occupy the whole space between the side

plates, and extend from top to bottom, or nearly so, and the placing of a steam chest above the top plate, extending nearly over the whole top, and into which steam is to be admitted from the boiler. The boiler holes are in the upper part of this steam chest, and between its bottom and the top plate of the stove is a flue space. The draught from the fire is to pass through tubes in the lower part of this boiler, into a flue space of about an inch between it and the back plate of the stove. The claim is to "the combination of the tubular boiler with the steam chest, the whole being constructed and arranged substantially as set forth."

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5. For *Wheels for Railroad Cars;* William W. Bergstresser, Harrisburg, Dauphin County, Pennsylvania, January 11.

This car wheel is to have a plate extending from the hub to the rim, and it is to be strengthened by radiating brackets extending from one to the other, as in some other wheels that have been patented; the patentee says: "I would have it understood that I am aware that railroad car wheels have been cast in a single piece, with a concave disk uniting the hub and rim, and provided with brackets to sustain the hub and rim, but in these cases the brackets sustaining the hub are placed on the side of the disk opposite to those sustaining the rim, and I do not therefore claim this as my invention; but what I do claim, and desire to secure by letter patent, is the concave disk in combination with the arms, or spokes, curved in the direction of the concavity of the disk, as described, to prevent breakage in cooling."

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6. For *Evaporating Kettles;* Charles C. P. Crosby, City of Brooklyn, New York, January 11.

"The general nature of my invention or improvement is the use of iron or copper kettles having a square or parallelogram form at the top, or upper edge, with a round or oval bottom, also in setting two or more rows of kettles in an arch, or furnace, with no middle wall, or partition, of brick or stone; also in casting the kettles of less width than length, so that more kettles, each of the same contents, can be placed in an arch or furnace, between the fire furnace and the chimney, than can be of round kettles."

It is proposed to construct the furnace by merely building side and end walls, and it is stated that if kettles four feet long and three feet wide be employed, two such kettles placed end to end, would require the side walls to be seven feet eight inches apart, which will allow two inches bearing for the flanches; that if the arch be eighty feet long, it will contain fifty of these kettles between the fire place and the chimney. The kettles are to have rims, or flanches at top, which are to be rectangular, and are to be supported by the resting of these flanches on bars or gratings of iron, extending from wall to wall.

The particular purpose to which these kettles are to be applied is not mentioned, but it is stated that kettles so constructed and set will evaporate 8000 gallons of water by the use of four cords of wood. The claim is to "the mode of constructing the kettles as herein des-

cribed; viz: by making the bottom of the kettle round, or ovoid, and the top square, or a parallelogram, the sides at the edge being straight, with a flanch or rim on each side of sufficient thickness to give strength to, and support the kettle, say of about two inches; in combination with the mode of setting the kettles in an arch, or furnace, as herein set forth."

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7. For a machine for *Husking and Shelling Corn;* Samuel S. Allen, Miamisburg, Montgomery County, Ohio, January 15.

"My machine consists principally of a vertical conical nut, set with teeth, which is made to revolve within a case or curb, which case or curb is composed in part of movable slats or staves, which are so hinged, or hung, at their upper ends, as to allow their lower ends to move in and out, said lower ends being borne up towards the conical nut by straight, spiral, or other springs, said case or curb also consists in part of stationary pieces of wood, or metal, which are situated between the edges, or joinings of the movable slats or staves, in such manner as to allow said slats to play in and out without opening their joints, so as to admit a grain of corn, or other matter, to insinuate itself between said joints, and consequently to interfere with the action of the machine."

"I do not claim to be the first to have constructed a machine for shelling corn by the aid of a revolving conical nut, furnished with teeth, and placed within a curb; nor do I claim to be the first to have used spring staves to bear the corn up against the revolving nut, but what I do claim in the above machine is the manner in which I have arranged and combined the hinged staves, furnished with springs, with the stationary pieces, so as to allow the said staves to spring out without opening the joints between them."

We have seen this machine in actual operation, and can aver, therefore, that its action is perfect, and that it appears to be capable of performing as much work with the same power as any machine with which we are acquainted.

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8. For *Wheels for propelling Steam Vessels;* Matthew W. King, City of New York, January 15.

The claim under this patent will furnish a good general idea of the nature of the invention.

"What I claim as constituting my invention is the placing of a separate bucket on three or more consecutive rows of arms; the making of the centre arms longer than those towards the sides, so as to increase the diameter of the wheel toward the centre; and the giving to the end of each bucket a rounding form, by which it strikes upon the water more easily and quickly than when made square."

The buckets are to be so placed upon the arms as that their planes shall form an angle with the radii of the wheel, of from twenty to forty-five degrees, so that the revolution of the wheels shall cause the propelling faces of the buckets to leave the water in a position nearly vertical.

9. For *Cleaning Grain, Cooling, Conveying and Bolting Flour;* Aaron Bull, Caroline, Tompkins County, New York, January 16.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the mode of cleaning, scowering and conveying grain, and cooling, bolting, and conveying flour, by a current of air produced by revolving fans, arranged in a horizontal, or inclined trunk, containing inclined planes for breaking the smut and sheltering the forward wheels from the current of air, and apertures for the escape of the smut, and apertures for the passsage of flour, grain, &c., as described."

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10. For making *Druggists' and other Boxes;* John H. Stevens, Assignee of C. E. Warner, City of New York, January 18.

This patent is taken for a lathe, or machine, for turning round boxes, of wood, such as are used for tooth powders, and various other purposes. This machine is described at great length, and the claims refer by letters to the particular devices as adopted by the patentee. It would be useless to attempt a general description of this machine, nor do we deem it a thing of importance, as we believe that it would be an easy task to perform all the operations with equal facility without interfering with the special arrangements described by the patentee.

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11. For an improved *Braiding Machine;* Dudley D. Sacket, Westfield, Hampden County, Massachusetts, January 22.

Those who know any thing of the braiding machine are aware of its unavoidable complexity. The machine as described in the specification of this patent is substantially the same with that heretofore in use; the improvements made, as pointed out in the claims, are "1st, In attaching the *form* to, and making it revolve with, the *carrier*, as described. 2nd, Attaching to the back of the *racer* a disk which plays into, and is carried by the carrier, as described. 3rd, In the employment of fly guides, for the purpose, and in the manner described."

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12. For making *Wrought Nails* for horse shoes, or other purposes; Theophilus Somerby, Wells, York County, Maine, January 22.

The general operation of this machine is the same with that of several others which have been essayed and abandoned; namely, the forming of nails from a rod, by means of dies formed on, or inserted in, rollers, to which a revolving or vibratory motion is given. This plan, therefore, could not be claimed, and that which is claimed, is contained within very narrow bounds, being to "the shear, or clipper, which separates the nail from the rod, in combination with the dies, and also the employment of the spiral spring inserted in the female die for throwing out the nail."

The defect in machines of this kind is in the formation of a feather, or burr, on the nails, along the closing edges of the dies; a difficulty which the apparatus described will not obviate.

13. For a *Tide and Current Wheel;* F. H. Southworth, City of St. Louis, Missouri, January 23.

"My tide or current wheel consists of a drum, or cylinder, revolving on an axis, which is generally placed vertically; said drum, or cylinder, being surrounded by buckets hinged thereto, so that they may open to receive the action of the water on one side thereof, whilst the buckets on the other side close, so as to pass round in the direction against that of the tide, or current, with little or no resistance. My principal improvement in the said wheel consists in the connecting together of the pairs of buckets which are diametrically opposite to each other, by means of rods jointed to said buckets, so that the opening or closing of one of them shall aid in effecting the reverse action in that with which it is connected." The claim is to the so connecting the buckets; and we have no doubt that the action of such a wheel will be much improved thereby; but in all cases where hinged buckets are to be opened and closed by the current of water, a large portion of the power is lost by the opening not taking place until the buckets have each passed to a considerable distance beyond the point at which it is generally supposed the force of the water will be communicated to them.

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14. For an improvement in the *Construction of Chimneys;* George H. Crossley, New Haven, Huron county, Ohio, January 28.

"The nature of this invention consists in constructing the jambs of the fire-place with two flues in each, said flues opening into a common funnel communicating with the main flue of the chimney, so that the apertures for admitting the air from the fire-places and rooms into the jambs, shall open into separate flues, instead of opening into a common flue; by means of which arrangement a draught will be created through the openings that will aid the draught of the chimney, while in the other case there being but one flue with only two apertures in it for admitting the air, the draught through one of these would have a tendency to obstruct the draught through the other." The foregoing is not a very clear announcement of the nature of the arrangement; nor can we make it clear without devoting more time and space to it than we are disposed to spare, as after a careful examination of the matter, we are not of opinion that the so-called improvement for curing smokey chimneys is likely to be productive of much benefit.

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15. For a *Grubbing Machine;* Young W. Short, Oglethorp county, Georgia, January 28.

This grubbing instrument consists of a piece of wood, or handle, about six feet long, and having another piece of wood about a foot long hinged to one end of it, in such manner as that when closed the handle and short piece will stand at about right-angles with each other. The parts which come together are faced with iron, or steel, grooved or furrowed like the jaws of pincers. The stuff to be grubbed is to be seized between these metallic plates, and the handle then consti-

tutes a lever, and the outer end of the short piece a fulcrum by which the grubbing is to be effected. The claim is to "the combination of the two pieces constructed and operating in the manner and for the purpose herein specified."

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16. For an improvement in *Grist Mills;* Elisha W. Welsh, Paris, Fauquier county, Virginia, January 20.

This improvement is in the manner of "keeping the bushes constantly against the spindles as they wear, and always lubricated;" and the claim is to "the self-adjusting mode of keeping the bush tight against the spindle by means of the wedges acting against the wedge-shaped sections of the bush, either by their own weight, or the addition of weights, as described." The arrangement which is the subject of this patent is so similar to others previously in use as not to merit a distinct description. We should say that there is not any substantial novelty in it, and we believe that any intelligent jury would confirm this opinion.

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17. For a *Plough;* Mahlon Smith, Tinicum, Bucks county, Pennsylvania, January 28.

The claims are to "the mode of securing the reversible cutter and share, by means of the vertical plate and its horizontal flanch, as set forth. To the mode of constructing and arranging the reversible rhomboidal cutter, so as to present four instead of two cutting edges, as described, and to the constructing the movable land-bar with a share, or wing attached, so that both may be advanced together." The numerous variations which are made the subjects of patents in ploughs, if described, would often present minute differences which do not appear to render the instrument either better or worse; and, at all events, an analysis of them would in most cases be equally difficult and profitless. Long continued use is the only test in most cases; and this is one which we cannot apply. In the case before us, we do not find any thing which calls for, or even admits of, special description.

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18. For *Removing Obstructions from Rail Road Tracks*; William and James Thorn, Plainfield, Essex county, New Jersey, January 29.

Two circular brushes are placed in front of the wheels of a locomotive, so that their bristles shall come into contact with the tops of the rails. The shafts upon which these brushes are placed stand horizontally, but making an angle, say of 45° with the rails, and they are driven by the contact of conical, or bevilled wheels, with the flanch of the front driving wheels. The patentees say, "We do not claim to be the inventors of revolving brushes for cleaning rail roads, but what we do claim to have invented is the before described mode of arranging the revolving brushes by placing them obliquely across the track; and in combination therewith the method of communicat-

ing the power to the brushes by means of the flanch on the front driving wheel acting on the conical wheel placed upon the axle of each of the revolving brushes, all as described."

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19. For a *Brick Machine;* Julius Willard, city of Baltimore, January 29.

The clay, placed within a box, is to be tempered by the revolution within the box of paddles placed upon a horizontal shaft. From this box the tempered clay is to be forced into a long sliding trough, the depth and width of a brick, and it is thus in part moulded, which moulding is completed by cutting the long strip of clay into proper lengths for a brick by means of wires stretched upon a frame, and so arranged as to answer that purpose. The claim is to "the manner of forming the clay into long strips by means of the moulding trough, constructed as described, and the combination of the same with the carriage and tempering apparatus."

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20. For an improvement in the *Shuttle;* James Baldwin, Nashua, Hillsbrough county, New Hampshire, January 31.

"The patentee says that his invention consists in furnishing the shuttle with such a spindle, spring, and catch, as will admit of the four conditions, or particulars, following, to wit: 1st. That the spring and catch be made of one piece, thereby avoiding the expense of separate catches and springs, and of fastening them separately to the body of the shuttle, as in all other shuttles now in use. 2nd. That the catch be fastened to the body of the shuttle by a screw, instead of playing upon a pin. 3rd. That by turning down the spindle with the bobbin upon it, into the mouth of the shuttle, it will be secured, and that it will be released by turning it up. 4th. That the head of the spindle be so formed, and the arrangements be such, that the spring shall press against that part of the head of the spindle which is back of the pin on which the spindle plays, instead of that part which is foward of said pin. The means and advantages of these arrangements are specially set forth and the following claim made.

"What I claim is the above described mode of furnishing the shuttle with a spring and catch in one piece, and so applying the spring to the spindle as that the rounded end of the head of the spindle shall come in contact with the spring, and by turning the spindle the catch is moved so as to release or receive the bobbin without any other operation."

Description of a Self-Acting Brake, for Rail Road Cars, for which letters patent of the United States were granted to GEORGE S. GRIGGS, *of Roxbury, in the county of Norfolk, Massachusetts, December* 31*st*, 1839.

We have been furnished by the patentee with the accompanying engravings of this apparatus, but as the view given of it, and the let-

ters of reference, do not correspond with those of the specification and drawings in the patent office, we give the following references to the engravings, and also the concluding part of the specification.

Fig. 1. Fig. 2.

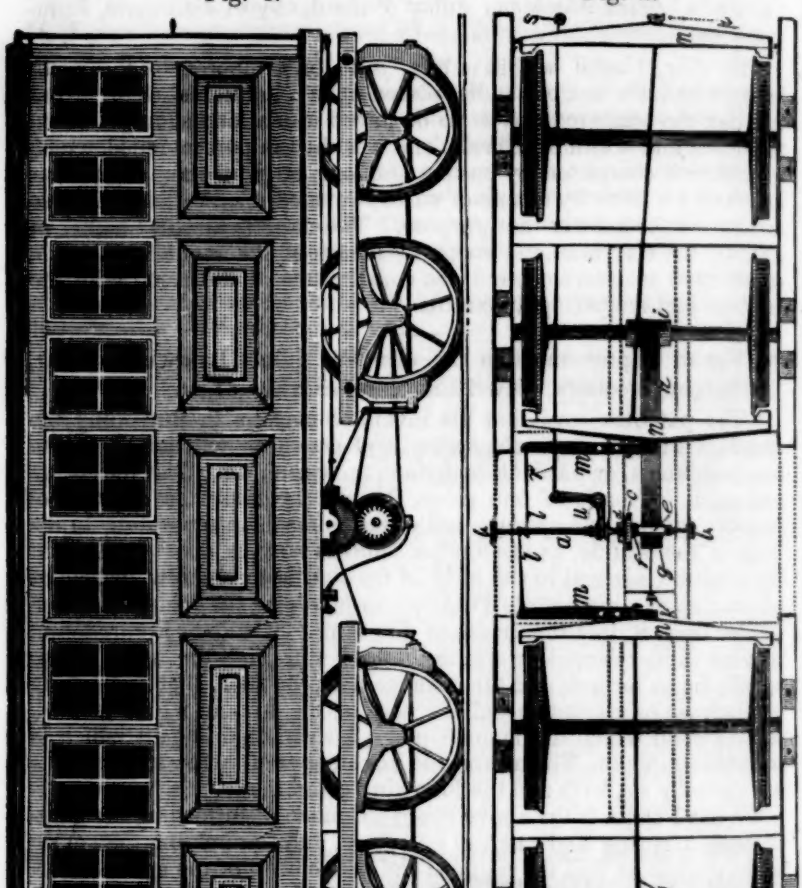

Fig. 1, is an elevation of an eight wheel car, with the *band and pulley brake*, attached. Fig. 2, an underside, or bottom, view of the brake.

a represents a shaft suspended to the body of the car by the boxes *b, b.*

c, a cog wheel which revolves on the shaft *a*, when not connected by the clutch *d*.

e, a frame suspended on the shaft *a*, supporting the pinion of the pulley *g*.

h, a belt passing over the pulley *g*, and the axle of the car *i*.

k, a tempering screw connected with the frame *e*, and with the body of the car, to keep the belt sufficiently tight just to allow the car wheels to turn, or to make them slide when the brakes are applied.

l, *l*, chains attached to the shaft *a*, and to the levers *m*, *m*, which wind round the shaft *a*, when the wheel *c*, is connected by the clutch on the shaft *a*.

m, *m*, levers connected to the brakes *n*, *n*, *n*, *n*, by the rods *o*, *o*, on one end of which are the tempering screws *p*, *p*, to adjust the brakes to the wheels, so that they shall cause them all to slide at the same time.

u, a forked lever supported by the frame of the car, to move the clutch *d*, by means of the rod *r*, which is connected with the upright lever *s*, the top of which is in the form of a T, to which is affixed lines leading to the engine, by which the wheel *c*, may be clutched to the shaft *a*, (the axle of the car acting on the pulley *g*, connected to the pinion *f*, by the belt *h*,) and cause the chains *l*, *l*, to wind on the shaft *a*, and thus to draw on the levers *m*, *m*, which being connected with the brakes *n*, *n*, *n*, *n*, cause them to stop the revolution of all the wheels.

"The advantages of this apparatus are, that the expense of brakemen may be saved, and the cars may be checked as soon as the engineer, or any other person forward sees danger; and the apparatus is much more effectual for this purpose than brakemen, and the danger arising from brakemen jumping off, as they sometimes do, is avoided, and the train is stopped much more suddenly than by the brakemen, without any shock, or strain; and in case of some cars of the train breaking loose, as they sometimes do, the lines may be so adjusted as that the lines for stopping the loose cars will, by the very circumstance of their breaking loose, be drawn until they are parted, and the loose cars thus stopped, instead of drifting along the railway, as they sometimes have done, to the great jeopardy of passengers.

"When the motion of the train is to be merely checked, but the train not stopped, the brakes of one or two cars, or more, that is to say as many as may be sufficient for the purpose, may be made to bear upon the wheels, the stopping of which, and their sliding on the rails, may be sufficient to check the speed as much as may be desired.

"I claim as my invention, and the subject of a patent, the causing of the revolution of the wheels to operate the brakes of railroad cars, in the manner, and by the mechanical contrivance substantially the same, and varying therefrom only in form; for the construction, as will be evident to every mechanic conversant with the subject, may be varied in its form very much without any invention, or the introduction of any new principle."

It appears from a number of testimonials of those who have used the foregoing brake, that it has fulfilled the intention of the patentee,

in a very satisfactory manner; we give, below, abstracts of four of these testimonials.

To Mr. G. S. Griggs,

For six months past, one of your band and pulley brakes has been in operation on a train of cars, of which I was engineer, on the Eastern Railroad, and I found it more effectual in stopping the progress of the train than any number of brakemen with the ordinary brakes. From the certainty of its operation I felt more confidence in being able to stop in case of difficulty, than with all others, with the complement of brakemen on a train. When moving at the rate of twenty-five miles an hour I could generally stop in the length of the train.

Yours, &c.,

Henry Thomas, Engineer.

Newburyport, July 22nd, 1840.

To Mr. G. S. Griggs,

Dear Sir,—Your patent band and pulley brake has been in use on our road for the last two months. I have seen and examined the operation of it daily, and in my opinion it is the best brake that has ever been applied to railroads. The safety of its operation is of the greatest importance to the traveling public, &c. &c.

S. Huestis, Boston and Providence R. R.

July 25th, 1840.

Under date of July 25th, 1840, Mr. Warren certifies that having used this brake upon the Boston and Worcester Railroad, at intervals, for the last year, he has found its operation very powerful, and that he believes that it has saved him from contact with cattle, and other obstructions on the track, on curves of the road, where they could not have been seen in time to have succeeded with the ordinary brake.

Mr. Geo. S. Griggs,

Dear Sir,—I have been employed for the last six years by the Boston and Providence R. R. Co., the last four of which I have had charge of a Locomotive Engine. During this period I have used many kinds of brakes, but have never found any so effectual as your patent brake, and I hope to hear of its being generally adopted by railroad corporations, as in my opinion it is not only the safest but the least expensive of any brake ever applied to railroad cars.

Yours, &c.

July 30th, 1840. Leonard Crossman.

Bibliographical Notice.

"*Remarks on the Mineralogy and Geology of Nova Scotia. By* Abraham Gesner, Esq., *Surgeon.*"

The above is the title of an octavo volume of about 250 pages, which was published at Halifax, N. S., some time since, but which

has but recently fallen under our notice. Were our pen less occupied, we would enter into a more formal review of this work than it is our intention now to do, and, probably, the present brief notice will be all that most of our readers would desire, more especially as we are compelled, after perusing it with care, to say that we find but little in it that can entitle the author to any praise as a writer, on descriptive mineralogy and geology. He has, certainly, shown some industry in collecting facts, but this has been done with little apparent disposition to inform his readers whence they were obtained, as a large portion of the book has, manifestly, been derived from a previous publication on the same subject, by two gentlemen of Boston, Dr. Jackson and Mr. Francis Alger, whose memoir he has not merely adopted as his model, but, to no small extent, has appropriated as his own.

Our present task will consist, principally, in furnishing some brief extracts from the work, and of short notices where extracts would occupy too much room, upon which extracts and notices the reader may make his own comments, and if these should not be of a character tending to exalt the reputation of the author for acumen and judgment, he alone must be responsible for the decision.

At page 11, we are told that the boulders of granite (rocking stones) were placed in their "present uneasy positions" by a volcanic eruption, instead of having been left there by the gradual decomposition of the rock beneath them.

Page 13. We are informed that the "sublimed sulphur" adhering to the sides of the transition rocks, in the vicinity of Halifax, shows that these rocks have been exposed to intense heat. Now we think it most probable that the substance here spoken of, is some saline efflorescence; if it is not, it will be difficult to convince geologists that its origin can be explained in this way.

Page 13 again. We learn that of which we were not before aware, that *sulphuret* of alumina and potash, form common alum.

Page 24. Here we find mention of primary clay slate, of which, we will risk our reputation, there never has been found a particle in Nova Scotia. The writer confounds it with the transition clay slate.

Page 29. "Sulphate of lime owes its origin to an affinity existing between lime and sulphur." This is a new discovery in chemical science.

Page 32. It is asserted that the ore of iron, at Clements, could not have been rendered magnetic by the igneous trap, because this rock is of a much later date. What of that? Has not the trap sent out immense dykes, which may be now seen running through the slate? and how could they have found their way there without carrying heat with them?

Page 34. Crystals of smoky quartz from Bridgetown, in the primary form. We have a desire to see some of them, as all we have hitherto seen from that place, are far removed from rhomboids.

Page 35. Here quartz crystals are cited as evidence of the igneous origin of granite. If we had no *better* proof of the igneous origin of granite, the nepturists might grapple with us with some effect.

Page 42. The theory given of the formation of blue vitriol is quite new to us. We did not know before, that "the air" could decompose sulphate of copper, so as to set free the sulphuric acid.

Page 46. We are informed that care should be taken to avoid the sulphuret of iron, as this salt hastens its destruction, and renders it unfit for roofing slate. Here is a salt hitherto unknown in chemistry.

Page 49. How does the author distinguish between old and new red sandstone, near Kentrilla, where he says "they are in contact?" We are satisfied that they belong to one and the same formation, though modified, perhaps, by local causes.

Page 52. Trilobites with two or more lobes. Query, how many lobes has a *trilobite?*

Page 65. It is said that in every instance the transition clay slate is above the granite. Surely such a natural and undisputed fact as this did not require this statement, and should not cause any wonderment.

Page 123. Here we find an attempt to illustrate a passage of scripture, which illustration, we doubt not, has appeared to many quite original, and which, in justice to the author's talent as a biblical interpreter, as shown upon several of his pages, we shall lay before our readers, entire. "Who can clearly decide that the flaming sword which forever shut out our first parents from Eden's delightful garden, was not a livid torrent of flame, issuing from the ground polluted by sin."

Page 126. It is said that there are no extensive formations of oolite in Nova Scotia. It would have been better to have said plainly that there were none at all.

Page 140. The copper ore at Carriboo River, is not found in veins, but beds, and the author should know the difference between them.

Page 147. One would suppose that phosphate of lime and arragonite, could readily be distinguished from each other.

Page 178. "We have not been able to discover that any of the crystals of specular iron ore possessed polarity." Here surprize is expressed at not finding what no body ever saw or heard of. Specular iron possessing polarity! it is scarcely magnetic.

Page 199. Here we have an occasional variety of analcime (the flesh coloured) confounded with the sarcolite of Thompson, (which

is the octahedral Keuphone spar) and described as occurring in the form of the primary *cube*, or gradually passing into the trapezohedron. Now we much doubt whether analcime, in a form *short* of the *perfect* trapesohedron has ever been found in Nova Scotia. It is probable that a very obtuse form of rhombohedral carbonate of lime had been mistaken for analcime.

Page 202. The mineral here described as Prehnite, has been shown to be a botryoidal variety of chalcedony. We have a piece of the very substance in our possession, which had been labeled Prehnite, by Dr. Gesner, and which we received from a source that may be relied upon. Of course, his description of the mineral was copied from the books, without examining it for himself.

Page 214. We should like to be informed when Sir Howard Douglass took the altitude of the precipice near Cape Split? We are inclined to think that the author has misquoted from a certain book, in which it was stated that Messrs. Jackson and Alger determined the height of this precipice, by means of Sir Howard Douglass's Semi-Reflecting Circle.

Page 217. We are told that the magnetic iron ore from Cape Blomidon, will yield "eighty-five per cent. of pure iron." If this be true, the author has discovered a new oxide of iron, containing more atoms of metal than those already known; for we had supposed that seventy-two per cent was the maximum of metal that the purest ore could contain. We advise him to make known his discovery forthwith; but we fear that he has not yet "had an opportunity to analyze it."

Page 219. The discovery of a mineral hitherto unknown in Nova Scotia, is here announced, viz.

Leocite. This mineral, however mortifying the truth may be to the author, proves to be nothing but trapesohedral analcime. If he had had the "opportunity to analyze it," he would have found its composition to conform to the formula for analcime, containing water and soda, instead of potash.

Page 219. We should suppose that leocite, and Messrs. Jackson and Alger's new mineral (Ledemite,) could not be easily confounded, as the latter occurs only in regular hexahedral prisms.

Page 248. Crystals of albin in the form of the octahedron. We have some misgivings on this point.

We have thus given the reader some idea of the character of this treatise on the mineralogy and geology of Nova Scotia, by a gentleman who has the reputation of being a man of science, and who has appeared before the public as a lecturer on chemistry, mineralogy, and geology. We think the references we have made, show, most

clearly, that at the time of writing the book, whatever may have been his attainments since, his knowledge of individual minerals was such that little dependence could be placed upon his descriptions, and that he betrayed his ignorance of some of the fixed principles of geology and chemistry. We could give other proofs of these assertions, should they be desirable; these are such as presented themselves in casually looking through the book. We will further observe, that a large number of the localities referred to, are not to be found in the map accompanying the work, and that the colouring of the map is by no means correct, though its principal and most accurate features have been copied (perhaps we ought to use a stronger word,) from the map prepared and published by Messrs. Jackson and Alger, who personally examined the same region several years before the publication by Dr. Gesner, and from whom, in other places, he has borrowed very liberally, with but a very summary and inadequate acknowledgment. Halifax itself, is represented as standing on primitive rock; and primitive, or granite, is the colouring given for nearly the whole formation of transition slate and quartz rock, when, in fact, the granite should be represented only in patches, here and there, as it happens to protrude itself through the slate.

Progress of Practical & Theoretical Mechanics & Chemistry.

Corrosion of Cast and Wrought Iron in Water. *By* Robert Mallet, A. I. C. E.

continued from page 128.

The author next proceeds to the important question of the protection afforded by paints and varnishes. White lead perishes at once in foul water, both fresh and salt; caoutchouc dissolved in petroleum appears the most durable in hot water, and asphaltum varnish or boiled coal tar laid on while the iron is hot, under all circumstances. The zinc paint, which is now so much noticed as an article of commerce, the author has analysed, and states its composition as—

Sulphuret lead,	9.05
Oxide zinc,	4.15
Metallic zinc,	81.71
Sesqui oxide iron,	0.14
Silica,	1.81
Carbon,	1.20
Loss,	1.94
	100.

It may, *à priori*, be considered likely to produce a most excellent body for a sound and durable paint under water. The black oxide of manganese has no advantages but that of being a powerful drier. The defects of all oil paints arise from the instability of their bases;

the acids which enter into the constitution of all fixed oils readily quit their weakly positive organic bases to form salts with the oxides of the metel on which they may be laid. Hence we must look for improvements in our paints to those substances among the organic groups which have greater stability than the fat or fixed oils, and which, in the place of being acid, or haloid, are basic or neutral. The heavy oily matter obtained from the distillation of resin, called "resenien," and eupion, obtained from rapeseed oil, have valuable properties as the bases of paints.

Tables IX and X contain the results as to the corrosion of cast-iron in sea water when exposed in voltaic contact with various alloys of copper and zinc, copper and tin, or either of these metals separately, per square inch of surface. It appears that neither brass nor gun metal has any electro-chemical protective power over iron in water, but, on the contrary, promotes its corrosion. This question is only a particular case of the following general question—viz: if there be three metals, A, B, C, whereof A is electro-positive, and C electro-negative, with respect to B, and capable of forming various alloys, 2 a + C.... A + C....A + 2C; then if B be immersed in a solvent fluid in the presence of A, B will be electro-chemically preserved, and A corroded, and *vice versa*. If B be so immersed in the presence of C, B will be dissolved or corroded, and C electro-chemically preserved—the amount of loss sustained in either case being determined according to Faraday's "general law of volta-equivalents." The tables show that the loss sustained by cast iron in sea water, as compared with the loss sustained by an equal surface of the same cast iron in contact with copper, is 8.23 : 11.37 ; and when the cast iron was in contact with an alloy containing seven atoms of copper and one of zinc, the ratio was 8.23 : 13.21 ; so that the addition in this proportion of an electro-*positive* metal to the copper produces an alloy (a new metal, in fact) with higher electro-negative powers, in respect to cast iron, than copper itself. The author discusses many results equally remarkable, and is, therefore, enabled to suggest, by its chemical notation, the alloy of "no action," or that which in the presence of iron and a solvent would neither accelerate nor retard its solution, one of the components of this alloy being slightly electro-negative, and the other slightly electro-positive, with respect to cast iron. These results will also enable some advances to be made towards the solution of the important problem proposed by the author in his former report—viz : "the obtaining a mode of electro-chemical protection, such that while the metal (iron) shall be preserved, the protector shall not be acted on, and the protection of which shall be invariable."

Table X exhibits especially the results of the action of sea water on cast iron in the presence of copper and tin, or their alloys. It appears that copper and tin being both electro-negative with respect to cast iron, all their alloys increase or accelerate the rate of corrosion of cast iron in a solvent, though in very variable degrees; the maximum increase is produced by tin alone, thus indicating that this metal (contrary to what was previously believed) is more electro-negative to cast iron than copper. Hence the important practical deduction, that,

where submerged, works in iron must be in contact with either alloy—viz: brass or gun metal; common brass, or copper and zinc, is much to be preferred. These experiments will also serve to demonstrate the fallacy from many of the patented so-called preservatives of oxidation, which are brought before the public with so much parade.

The author, lastly, proceeds to the subject of the specific gravity of cast iron, tables of which are added to the preceding. The specific gravities here recorded were taken on equal sized cubes of the several cast irons cut by the planing machine, from bars of equal size, cast at the same temperature, in the same way, and cooled in equal times. Many of these results differ considerably from those given by Dr. Thompson and Mr. Fairbairn; which the author refers to the probability that those of Dr. Thompson were taken from pieces of the raw pig, and those of Mr. Fairbairn by weighing in air equal bulks cut from the mass by the chisel and file, by which latter process the volume is liable to condensation. The experiments of Mr. Fairbairn and Mr. Eaton Hodgkinson seem to show that the ultimate strength of cast iron is in the ratio of some function of the specific gravity dependent upon the following conditions—viz: 1. The bulk of the casting; 2. The depth or head of metal under which the casting was made; 3. The temperature at which the iron was poured into the mould; 4. The rate at which the casting was cooled.

Table XI. All the irons experimented on are arranged in classes, according to the character of the fracture; for which purpose the terms—1. Silvery, 2. Micaceous, 3. Mottled, 4. Bright grey, 5. Dull grey, and 6. Dark grey, have been adopted by the author as a sufficient basis on which to rest a uniform system of nomenclature for the physical characters of all cast irons, as recognisable by their fracture; and it is to be wished that experimenters in future would adopt this or some other uniform system of description, in place of the vague and often incorrect characteristics commonly attached to the appearance of the fracture of cast iron.

The twelfth and last table contains the results of a set of experiments on the important subject of the increase of density conferred on cast iron, by being cast under a considerable head of metal, the amount of which condensation had not been previously reduced to numbers. It shows an increase of density in large castings, for every two feet in depth, from two to fourteen feet deep of metal.

A very rapid increase of density takes place at first, and below four feet in depth a nearly uniform increment of condensation.

The importance of these results is obvious; for, if the ultimate cohesion of castings is as some function of their specific gravity, the results of experiments in relation to strength, made on castings of different magnitudes, or cast under different heads, can only be made comparable by involving their various specific gravities in the calculation.

Mining Jour. Nov. 1840.

Electric Telegraph.

This extraordinary machine is now being worked on the Great Western Railroad, between Drayton and Paddington; and, though no distinct idea of the apparatus can be imparted without plates and draughts of the dial, pipes, rods, &c., of which it is composed, yet the principle will excite unqualified admiration when our readers learn that intelligence is conveyed at the rate of 200,000 miles per second, or 8000 times quicker than light travels during the same period, by means of electrical currents passing through coils of copper wire, placed immediately behind some fine magnetic needles, made to operate upon a circular series of twenty letters, which indicate such terms, either separately or collectively, as they have been arranged to represent. This telegraph will act both day and night, in all states of the weather, and with a rapidity so superior to the common process, that one minute only is required for the communication of thirty signals.

Ibid., August, 1840.

On the Composition of Crystallized Phosphoric Acid. By M. Eugene Peligot. Acad. des Sciences, 4th May, 1840.

M. Peligot refers to the experiments of M. Graham upon the combinations of phosphoric acid with water, and quotes the passage in which he supposes the existence of three compounds of this acid, with one, two, and three atoms of water respectively. He then gives an account of some experiments which he has recently made upon some crystaline substances found in bottles of phosphoric acid, which had been preserved for some years. The analyses of these crystals prove them to be compounds of phosphoric acid, respectively with three and two atoms of water, (PhO^5, 2HO and PHO^5, 3HO.)

Annales de Chimie et de Physique, March, 1840.

Memoir on the Examination for Arsenic in Judicial Inquiries. By M. L. Figuier.

After remarking upon the inconveniences which attend the use of Maesh's apparatus and its modifications by Liebig, Berzelius, Chevalier, and Orfila, M. Figuier traces the plan by which he proposes to avoid these evils.

The suspected matters are first cut into pieces, and boiled for four or five hours in water, a slight alkaline re-action being maintained in the liquid.

When cold, the fatty matters which swim on the surface are separated, and the liquid filtered.

The filtered liquid is then slightly acidulated by hydrochloric acid, evaporated to dryness, and the residuum dried but not carbonized.

It is then redissolved in warm water, and filtered to separate the deposit caused by desiccation.

The brown liquid thus obtained is submitted to a current of washed chlorine gas, until it ceases to be rendered turbid by the gas. The precipitate is again separated by filtration, and the liquid boiled in a porcelain capsule to expel the chlorine. The liquid is then introduced into a modification of Marsh's apparatus.

This consists of a flask closed by a cork, which is traversed by two tubes, one of which terminates at its upper extremity in a funnel, and descends to near the bottom of the flask. The other is a bent tube of about one-fourth of an inch in diameter, and drawn out at its extremity. In the horizontal part are placed some pieces of fused chloride of calcium, and farther on some fragments of porcelain; to this latter part of the tube the heat is to be applied.

About fifty grammes of zinc are placed in the flask, and the cork being put in place, sulphuric acid diluted with seven times its weight of water is poured in by the funnel tube. Hydrogen is formed which drives out the air from the apparatus. When the disengagement of the gas has gone on sufficiently long to avoid the danger of an explosion, that portion of the tube which contains the porcelain is heated to redness, and then the decoction, prepared as above, is poured into the flask. If the mixture in the flask foams so much as to be likely to enter the tube, five or six grammes of alcohol poured in through the funnel will check it instantly.

If the liquid examined contain any traces of arsenical poison it will soon shew itself at a short distance from the point heated red hot, and in the part of the tube drawn out, as a small brilliant circle of metallic arsenic, which augments as the operation proceeds; when this ceases to increase, the operation, which should last one or two hours, is stopped. The tube is cooled and separated from the rest of the apparatus. The characters of the metal may then be tested without injury to its metallic appearances. Finally the tube is hermetically closed at both ends, by the lamp, and preserved to be produced in court.

Journal de Pharmacie, October, 1840.

A New Blue Ink prepared from Prussian Blue.

Saturate with care, pure Prussian blue, with one-sixth of oxalic acid, and a little water, so as to form a paste, which is free from clots. It is then diluted with rain water until the desired shade is obtained, which is told by trying it upon white paper.

The colour is extremely deep; if the liquor is but slightly diluted, the writing appears perfectly black, and gives, upon drying, a copper lustre. By dilution the most beautiful shades are produced, even to the brightest azure. A slight addition of gum thickens the ink and prevents it from soaking through thin paper. Of course this ink is not indestructible; caustic potassa, hydrochloric acid, and water remove it. Messrs. Stephen and Nash have taken out a patent for it in England.

Ibid.

On a New Alum. By Dr. Mohr.

For sometime past there has been introduced into the German market an alum said to contain, in a state of great concentration, the principles which are principally active in dyeing and printing. This quality, it is said, renders its employment more advantageous, and diminishes considerably the expense of transportation. This alum has not the least resemblance to the ordinary potash alum, for it presents no trace of crystallization, but is in flat quadrangular plates, about an inch thick; it is white, feebly transparent, and dissolves very easily in water; its taste is sweetish, bitter, and aluminous, but much less stong than that of ordinary alum. If pulverized sulphate of potassa is thrown into a concentrated solution of this alum, a crust of common alum forms directly. Mr. Mohr has found its composition to be,

Alumina, - -	13.91
Sulphuric acid, -	36.24
Potassa, - - -	1.50
Water, - -	49.60

We see by this composition that the alum in question is, properly speaking, but a pure sulphate of alumina with eighteen atoms of water of crystallization. A compound mentioned by Berzelius in his Traitè de Chimie, and which in 100 parts contains 48.53 water of crystallization. It is probably prepared from pipe-clay, calcined and pulverized, and sulphuric acid not entirely concentrated; the mixture is boiled to dryness in appropriate vessels, by a strong fire, whence its peculiar non-crystalline appearance. This new alum is altogether free from iron, and replaces the ordinary alum in all its uses; but it is for the preparation of the mordant, acetate of alumina, that it offers the most essential advantage. In fact, as it contains scarcely any sulphate of potassa, one fourth the quantity of acetate of lead is saved in its decomposition by that salt, since the ordinary alum contains three atoms of sulphate of alumina and one of sulphate of potassa. Ibid.

Mechanics' Register.

Power of Steam.—The greatest load lifted by any engine now at work in this country was by one in the Consolidated Mines, which raised a load of 9000 lbs. every double stroke it made, and did this nine times a minute, amounting to 267,022 tons, lifted seven feet six inches in twenty-four hours; and this astonishing machine could be started, stopped, or regulated, by a little boy.

Mining Jour. July 1840.

Salt Mine in Switzerland.—A salt mine has been discovered at Rheinfelden, in the canton of Argau, which the Swiss papers expect will be sufficiently abundant to supply all Switzerland, and thus save to the Confederation the 500,000 francs annually drawn from it for the purchase of foreign salt.—*Galignani's Messenger.*

Ibid. Aug. 1840.

Capital of Great Britain.—The grand total capital represented by all property in Great Britain and Ireland is estimated at 3,629,000,000*l.* The value of all sorts of public property is 103,000,000*l.* The value of lands, ships, canals, rail-roads, mines, horses, cattle, timber, crops, &c., is estimated at 2,945,000,000*l.* The value of all sorts of furniture, apparel, plate, specie, money in chancery, savings' banks, &c., is estimated at 580,000,000*l.* The national debt is about 764,000,000*l.*

Ibid, 1840.

Spontaneous Gas Company.—The directors of this company are actively prosecuting their unprecedented project. Pipes are casting, and ere many weeks have passed away, the Newcastle and North Shields railway will, in all probability, be lighted from the great natural reservoir of gas at Wallsend.—*Northern Times.*

Ibid, September, 1840.

French Steam Engines.—There are in France 950 steam engines, 719 French, 144 foreign, and 87 of unknown origin. Of 863 engines of known origin, 334 are low pressure, and 429 high pressure.

Ibid, 1840.

Meteorological Observations for January, 1841.

Moon.	Days	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Wind. Direction.	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inch's	Inch's			Inches.	
	1	22	23	29.93	29.50	E.	Brisk.	.85	Cloudy—snow and hail.
	2	16	28	.40	.45	W.	Moderate.		Clear—clear.
	3	4	6	.70	.75	W.	Brisk.		Clear—clear.
	4	4	19	30.05	30.06	W.	Calm.		Clear—lightly cloudy.
	5	14	25	.30	.33	E.	Moderate.		Cloudy—cloudy.
	6	35	36	.15	.75	E.	do	1.20	Rain—rain.
⊙	7	51	55	29.90	29.80	S.	Brisk.	1.00	Cloudy—rain.
	8	39	48	.90	.90	W.	Moderate.		Clear—clear.
	9	32	42	.95	30.00	W.N.	do.		Clear—lightly cloudy.
	10	33	36	30.00	.00	E.N.E.	do.		Cloudy—drizzle.
	11	38	44	29.80	29.70	E.	do.		Rain—rain.
	12	37	45	.96	.96	W.	do.		Clear—clear.
	13	33	34	30.10	.90	E.	do.	.70	Snow—snow.
☽	14	32	32	.00	30.10	E.	do.		Cloudy—cloudy.
	15	30	33	.05	.05	E.	do.	.15	Fog—fog.
	16	30	37	.23	.23	W.	Brisk.		Drizzle—cloudy.
	17	33	41	29.75	29.65	S.W.W.	Calm.	.60	Rain—cloudy.
	18	17	16	30.10	.90	W.	Moderate.		Clear—lightly cloudy.
	19	8	15	.30	30.53	N.W.	do.		Clear—hazy.
	20	18	29	.50	.40	N.E.	do.	.45	Snow—snow.
	21	32	36	29.80	29.74	N.E.	do.	1.05	Sleet—drizzle rain in night.
⊗	22	33	33	.80	.84	W.	do.	.15	Cloudy—cloudy.
	23	24	32	.75	.76	W.	do.		Cloudy—partially cloudy.
	24	30	44	.83	.75	S.E.E.	do.		Cloudy—lightly do.
	25	31	43	.70	.70	W.	do.		Clear—clear.
	26	26	46	30.10	30.15	W.	do.		Clear—do.
	27	36	42	29.86	2.50	S.W.W.	do.	.02	Cloudy—cloudy.
	28	33	46	30.15	30.10	W.	do.		Clear—cloudy.
	29	34	34	.10	29.90	E.	do.	.38	Rain—rain.
☾	30	32	40	29.90	.95	W.	do.		Partially cloudy.
	31	28	41	30.00	.96	W.	do.		Partially cloudy—cloudy.
	Mean	27.97	34.97	29.98	29.94			6.56	

	Thermometer.		Barometer.	
Maximum height during the month,	55.00	on the 7th.	30.75	on the 6th.
Minimum " "	4.00	on the 3rd and 4th.	29.40	" 2nd.
Mean	31.47		29.96	

METEOROLOGICAL REPORT

FOR THE STATE OF PENNSYLVANIA,

Collated from returns made to the Committee on Meteorology of the Franklin Institute of the State of Pennsylvania, for

MARCH, 1841.

	County.	Town.	Observer.	Thermometer. 7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum.	Mean.	Days omitted.	Register. Lowest.	Mean.	Days omitted.	Barometer. 7, A. M.	2, P. M.	9, P. M.	Maximum.
1	Philadelphia,	Philadelphia,	G. P. Schively,	37.16	48.94	41.55	71.50	19.50	42.55	.	19.00	31.81	.	30.04	30.03	30.04	30.44
2	Montgomery,																
3	Bucks,	Newtown,	L. H. Parsons,	34.22	45.45	36.35	74.00	20.00	38.67	3/3	17.50	29.31	.	29.99	29.98	29.97	30.47
4	Lehigh,																
5	Northampton,	Easton,	Charles Elliot,														
6	Monroe	Stroudsburg,	A. M. Stokes,	28.23	48.42	37.50	72.00	15.00	38.05	15 1/3	....	....	.	29.25	29.26	29.19	29.75
7	Pike,	Milford,	Ralph Bull,														
8	Wayne,	Honesdale,	W. Richardson,														
9	Susquehanna,	Silver Lake,	E. Rose,	31.29	42.26	36.00	69.00	10.00	36.52	.	10.00	27.75	.	28.05	28.06	28.06	28.36
10	Luzerne,	Wilkesbarre,	W. F. Dennis,														
11	Schuylkill,	Port Carbon	P. C. Lyceum,	30.39	47.70	33.65	81.00	15.00	37.25	2	15.00	26.00	1	29.29	29.28	29.27	29.90
12	Berks,	Reading,	C. F. Egelmann,	33.74	43.39	36.81	73.00	18.00	37.98	.	14.00	29.29	.	29.82	29.75	29.83	30.38
13	Chester,	West Chester,	Wm. W. Jefferis,	33.26	44.01	37.24	67.50	20.00	38.17	6 2/3	17.50	30.04	6	29.47	29.47	29.46	29.87
14	Delaware,	Haverford,	Haverford School,	35.87	44.73	40.52	68.00	20.00	40.37	1 1/3	16.00	30.77	.	29.52	29.45	29.49	29.87
15	Lancaster,	Lancaster,	Conservatory of Arts,	35.10	49.16	38.63	73.50	18.50	40.96	.	18.50	32.02	.	29.44	29.41	29.41	29.84
16	York,																
17	Lebanon,																
18	Dauphin,	Harrisburg,	J. Heisely,	36.03	43.42	41.25	66.00	23.00	40.23	1	20.00	32.23	1	29.75	29.71	29.71	30.16
19	Northumberland,	Northumberland,	Andrew C. Huston,	32.11	43.90	36.06	70.00	15.00	37.36	.	11.00	25.41	.	29.41	29.38	29.39	29.81
20	Columbia,	Danville,	C. H. Frick.														
21	Bradford,																
22	Tioga,																
23	Lycoming,																
24	Union,																
25	Mifflin,																
26	Juniata,	Mifflintown,	J. A. Kinkead,	30.02	46.50	34.84	82.00	10.00	37.12	1 2/3	....	....	.	29.47	29.41	29.41	29.87
27	Perry,																
28	Cumberland,	Carlisle,	Prof. W. H. Allen,														
29	Adams,	Gettysburg,	Prof. M. Jacobs,	33.01	46.72	37.59	75.50	14.00	39.11	.	13.00	30.50	.	29.33	29.30	29.33	29.68
30	Franklin,																
31	Huntingdon,	Huntingdon,	Prof. Jacob Miller,	29.97	47.77	34.77	78.00	7.00	37.50	1/3	....	....	.	29.29	29.25	29.27	29.67
32	Centre,	Bellefonte,	John Harris,														
33	Potter,																
34	M'Kean,	Smithport,	M. R. Atkins,	22.35	37.94	28.55	64.00	—6.00	29.61	.	....	....	.	....	....	....	....
35	Clearfield,																
36	Cambria,	Ebensburgh,	Richard Lewis,	26.45	40.83	30.13	73.00	00.00	32.47	4/3	00.00	25.29	.	27.77	27.75	27.78	28.15
37	Bedford,	Bedford,	Samuel Brown,	33.38	48.32	37.05	77.50	11.00	39.58	.	....	....	.	29.19	29.15	29.15	29.52
38	Somerset,	Somerset,	George Mowry,	28.41	41.11	33.39	70.00	1.00	34.30	3	1.00	25.41	3	27.82	27.83	27.81	28.50
39	Indiana,	Indiana,	Richard White,	35.23	42.47	31.69	76.00	12.00	36.46	1 1/3	....	....	.	28.52	28.51	28.51	28.90
40	Jefferson,	Rose Cottage,	C. C. Gaskell,														
41	Warren,	Warren,	J. E. King,	29.35	42.93	33.13	70.00	00.00	35.14	.	....	....	.	28.61	28.60	28.60	28.96
42	Venango,	Franklin,	Wm. Connely,	23.32	46.43	31.84	76.00	—13.00	33.86	1/3	....	....	.	28.85	28.87	28.89	29.25
43	Armstrong,																
44	Westmoreland,																
45	Fayette,	Uniontown,	J. P. Weethee,	32.68	46.35	34.92	82.00	—1.00	37.98	.	....	....	.	28.97	28.97	28.98	29.38
46	Green,																
47	Washington,	Cannonsburg,	Prof. A. H. Campbell,														
48	Alleghany,	Pittsburgh,	J. P. Bakewell,	36.33	46.93	....	80.00	10.00	41.63	11	....	....	.	29.15	29.13	29.16	29.63
49	Beaver,	Beaver,	James Allison,														
50	Butler,	Butler,	Jacob Mechling,	31.32	44.29	39.16	76.00	—2.00	38.26	.	....	....	.	28.67	28.72	28.71	29.10
51	Mercer,	West Greenfield,	S. Campbell,														
52	Crawford,	Meadville,	David Dick,	25.09	46.35	33.13	76.00	—17.00	34.86	8	—18.00	20.09	8	28.98	28.96	28.96	29.45
53	Erie,	Erie,	Park & Reid,														

egister.			Barometer.							Weather.							W								
	Mean.	Days omitted.	7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum	Mean.	Days omitted.	Clear.	Cloudy.	Days omitted.	Rain.	Snow.	Rain and Snow.	Thunder Showers.	Rain in inches.	North.	N. N. E.	N. E.	E. N. E.	East.	E. S. E.	S. E.	S. S. E.	
0	31.81	.	30.04	30.03	30.04	30.44	29.35	30.04	.	15⅔	15⅓	.	....	....	....	..	.....	1	2	6	1	⅔	⅔	1⅓	.	
0	29.31	.	29.99	29.98	29.97	30.47	29.26	29.98	⅔	10⅔	19	1⅓	3	6	....	..	4.952	2⅔	⅔	6	⅓	.	.	⅓	⅓	
	....	.	29.25	29.26	29.19	29.75	28.03	29.23	14	5	11	15	2	7	. ..	..	.....	1⅓	1	1⅔	.	7	.	⅔	.	
0	27.75	.	28.05	28.06	28.06	28.36	27.77	28.06	.	13	18	.	4	2	....	..	1.755	6⅓	.	2	.	.	.	⅔	.	
0	26.00	1	29.29	29.28	29.27	29.90	28.62	29.28	2	10⅓	18⅓	2	3	6	3	1	3.376	.	⅓	7	⅓	1	.	⅓	⅓	
0	29.29	.	29.82	29.75	29.83	30.38	29.25	29.80	.	9⅔	21⅓	.	2	4	3	1	.....	1	.	3⅔	.	2⅔	.	⅓	.	
0	30.04	6	29.47	29.47	29.46	29.87	28.80	29.47	6⅔	.	.	.	2	5	4	..	.....	2⅔	2	2⅔	.	2⅓	⅓	⅓	.	
0	30.77	.	29.52	29.45	29.49	29.87	28.98	29.49	.	7	24	.	11	....	....	..	4.031	⅔	1	4⅔	⅓	.	.	1⅔	⅓	
0	32.02	.	29.44	29.41	29.41	29.84	28.98	29.42	.	13⅓	17⅔	.	3	4	5	..	4.057	4	⅓	5⅓	1	3	⅓	2	.	
0	32.23	1	29.75	29.71	29.71	30.16	29.05	29.72	1	.	.	.	2	5	1	..	3.820	⅔	.	⅓	.	1⅓	.	5	.	
0	25.41	.	29.41	29.38	29.39	29.81	28.72	29.39	.	8	23	.	3	9	3	1	3.774	4⅔	⅔	4⅓	.	4⅓	.	3	⅓	
	....	.	29.47	29.41	29.41	29.87	28.27	29.43	1⅔	8⅔	20⅔	1⅔	2	6	1	1	.....	.	.	4⅓	.	2	.	2⅔	.	
0	30.50	.	29.33	29.30	29.33	29.68	28.60	29.32	.	12⅔	18⅓	.	6	2	2	..	5.367	5⅓	2	3⅔	⅔	1	.	⅓	.	
	....	.	29.29	29.25	29.27	29.67	28.68	29.27	⅓	13	18	.	2	6	1	..	2.705	.	.	.	.	11	.	.	.	
	....	.	....	....	....	....	....	....	.	13⅓	17⅔	.	2	12	....	..	.. ...	1	.	3	.	6⅓	.	3	.	
0	25.29	.	27.77	27.75	27.78	28.15	27.24	27.77	⅓	8	22⅔	⅓	1	10	....	..	.....	⅔	.	1⅓	.	1⅔	.	4⅔	.	
	....	.	29.19	29.15	29.15	29.52	28.55	29.16	.	13	18	.	2	5	....	..	.....	⅓	⅔	.	⅔	.	⅔	4	⅔	
0	25.41	3	27.82	27.83	27.81	28.50	27.29	27.82	3	12	16	3	3	10	2	..	2.172	⅔	⅔	.	⅔	2⅔	⅔	.	⅔	
	....	.	28.52	28.51	28.51	28.90	28.00	28.51	1	9⅓	20⅔	1	4	11	....	..	2.353	.	.	1	.	.	.	2	.	
	....	.	28.61	28.60	28.60	28.96	28.05	28.60	.	6	25	.	....	....	....	..	.....	.	.	2	.	1⅔	.	6⅔	.	
	....	.	28.85	28.87	28.89	29.25	28.29	28.87	5	9⅔	16⅓	5	6	4	....	..	4.134	.	.	.	.	.	.	12	.	
	....	.	28.97	28.97	28.98	29.38	28.50	28.97	.	15	16	.	2	7	....	..	3.625	1⅓	.	1	.	.	.	3	.	
	....	.	29.15	29.13	29.16	29.63	28.30	29.15	2⅓	10⅔	18	2⅓	3	6	1	2	3.007	.	.	3	.	2	.	3⅔	.	
	....	.	28.67	28.72	28.71	29.10	28.20	28.70	.	16⅓	14⅔	.	5	9	....	1	4.677	.	.	3⅓	⅓	10⅓	.	.	.	
0	20.09	8	28.98	28.96	28.96	29.45	28.40	28.97	8	8⅔	11⅓	10⅔	....	....	....	..	.....	2⅓	.	.	.	⅓	.	1⅓	.	

Winds.														Hygrometer.					
E. S. E.	S. E.	S. S. E.	South.	S. S. W.	S. W.	W. S. W.	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.	Dew-point.	Days omitted.	Diff. therm. and dew-point.	Wet Bulb.	Days omitted.	No. of Report.
3/5	1 1/2	.	2	1 2/3	3 1/3	.	2 1/2	1/3	7 1/3	3/5	.	.	....	.	.....	....	.	1423
.	1/3	1/3	1/3	1/3	6	1	1	2 1/3	2 2/3	.	.	1 1/3	....	.	.....	....	.	1498
.	2/3	.	2/3	2/3	2 2/3	.	3 1/3	.	2 1/3	.	.	9 2/3	....	.	.....	....	.	1424
.	2/3	.	5 1/3	.	2 1/3	.	8	1/3	6	.	.	.	....	.	.....	....	.	1433
.	1/3	2/3	1/3	.	1/3	1 1/3	3 1/3	.	5 1/3	1 1/3	7	2 1/3	....	.	.....	....	.	1422
.	2/3	.	1/3	.	1	.	4	.	14	.	1 1/3	.	....	.	.....	....	.	1439
1/3	1/3	.	1	.	1/3	2/3	2 1/3	3	4 2/3	.	1 1/3	7 1/3	....	.	.....	....	.	1416
.	1 1/3	1/3	1	.	3 1/3	1	.	1 1/3	5 2/3	.	.	10	35.32	.	.....	....	.	1429
1/3	2	.	2 2/3	1 1/3	1 1/3	1	5 1/3	2	1 1/3	.	.	.	30.96	.	.....	41.85	.	1469
.	5	.	2 1/3	.	2/3	.	2	.	17 2/3	.	.	1	....	.	.....	....	.	1415
.	3	1/3	2 2/3	.	1	.	6	2/3	2 1/3	.	1	.	....	.	.....	....	.	1446
.	2 2/3	.	.	.	3 1/3	.	1 1/3	.	4 1/3	.	11 1/3	1 2/3	....	.	.....	....	.	1419
.	1/3	.	2 1/3	2/3	4 2/3	.	4 1/3	1/3	1 2/3	.	4 1/3	.	28.25	2 2/3	.....	40.96	1 1/3	1472
.	.	.	.	.	.	.	19 2/3	.	.	.	.	1/3	....	.	.....	....	.	1421
.	3	.	1/3	.	1 2/3	.	10	.	5 2/3	.	.	.	....	.	.....	....	.	1434
.	4 1/3	.	1/3	.	6 2/3	.	7 1/3	1/3	3	.	4 2/3	1/3	....	.	.....	....	.	1427
3/5	4	3/5	.	2/3	4 1/3	6	1 1/3	8	3 3/5	.	.	.	....	.	....	....	.	1420
.	2/3	.	1/3	1	2	2/3	7 2/3	1/3	3/5	.	10	3	....	.	.....	....	.	1459
.	2	.	1 1/3	.	6 1/3	.	4 1/3	.	6 2/3	.	8 1/3	1	....	.	...	....	.	1436
.	6 2/3	.	2/3	.	4 1/3	.	4 2/3	.	5	.	6	.	....	.	.....	....	.	1426
.	12	.	.	.	2 1/3	.	.	.	11 1/3	.	.	5	....	.	.....	....	.	1432
.	3	.	.	2/3	13	.	2 2/3	.	4 2/3	.	4 2/3	.	....	.	.....	....	.	1444
.	3 1/3	.	1/3	.	2	.	1 1/3	.	9 1/3	.	6 1/3	2 1/3	....	.	.....	....	.	1431
.	.	.	.	1/3	8 2/3	.	7 1/3	.	1/3	.	.	.	....	.	.....	....	.	1421
.	1 1/3	.	4 1/3	.	1	.	2/3	.	4 1/3	.	6	10 2/3	....	.	.....	....	.	1464